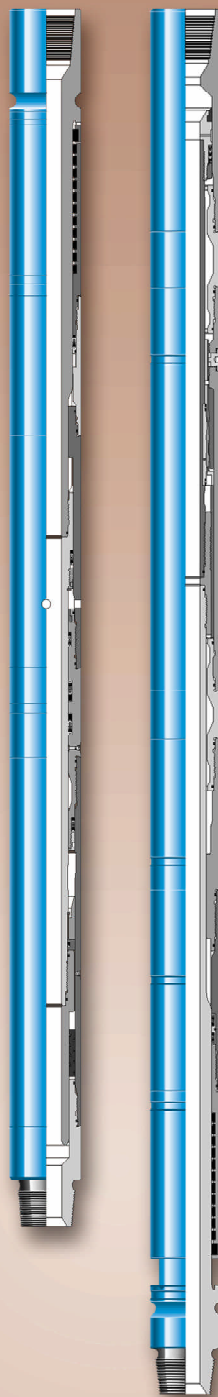


HYDROMECHANICAL DRILLING JARS

Instruction Manual 4200



Hydromechanical Drilling jars

One Company Unlimited Solutions



NATIONAL OILWELL VARCO

Hydromechanical Drilling Jars

INDEX

Hydromechanical Drilling Jars

General Description	3
Explanation of Mechanism	3
Operation	8
Placement in the String	8
Drilling	8
Tension Drilling	8
Compression Drilling	8
To Jar Upward	8
To Jar Downward	9
Load Calculations	9
Straight Hole Conditions	9
Crooked Hole Conditions	9
Effect on Up Jar	9
Effect on Down Jar	11
To Jar Up	11
To Jar Down	11
Troubleshooting	11
Up Jar Will Not Trip	11
Down Jar Will Not Trip	11
Maintenance	11
Rig Floor Maintenance	11
Dressing Area Maintenance	13
Disassembly of Up Jar Section	13
Reassembly of Up Jar Section	17
Filling the Up Jar	18
Testing the Up Jar	21
Disassembly of Down Jar Section	21
Resassembly of Down Jar Section	21
Testing the Down Jar	23
Strength Data	17, 23
Service Kit	24
Specifications and Replacement Parts	25 – 29

9" Hydromechanical Drilling Jar

Disassembly of 9" Up Jar Section	30
Reassembly of 9" Up Jar Section	31
Filling the 9" Up Jar	35
Testing the 9" Up Jar	35
Disassembly of 9" Down Jar Section	35
Reassembly of 9" Down Jar Section	36
Testing the 9" Down Jar	38
Specifications and Replacement Parts	39 – 40

The designs and specifications for the tools described in this instruction manual were in effect at the time this manual was approved for printing. National Oilwell Varco, whose policy is one of continuous improvement, reserves the right to discontinue models at any time, or to change designs and specifications without notice or without incurring obligation.

Ninth Printing, September 2005

General Description

Bowen Hydromechanical Drilling Jars

provide upward and downward jarring blows for freeing stuck drill strings.

The Bowen Hydromechanical Drilling Jar consists of two separate sections — Up Jar Section and Down Jar Section — which are connected by a standard tool joint (see front cover). The Up Jar section operates hydraulically and is capable of striking upward jarring blows of infinitely variable intensity, up to its maximum, by simply changing the upward pull of the drawworks. The Down Jar section has a mechanical trip mechanism which is set at a predetermined downward trip load, up to its maximum, at the surface before going in the hole. No special preparation is required before running the jars in the hole.

The impact load developed in the jars is several times greater than the trip load. This high impact load is delivered to the stuck point in the string below the jar.

The two section design of the tool allows transportation, handling, storage and maintenance to be done in approximately fifteen foot sections. More importantly, it allows the Jars to be positioned separately in the drill string, if desired, eliminating the stiffness of a thirty foot long tool.

There are several rubber rings in each jar which act to stabilize the mandrel and to absorb lateral shock. A secondary function of the rings is to serve as a back-up for the outboard wiper if it becomes damaged in service.

Under normal conditions these jars will operate in downhole temperatures to 325°F, but by maintaining proper circulation they can operate in formation temperatures up to 400°F.

High temperature packing is available which allows the jars to operate in formation temperatures up to 600°F. The Hydromechanical Drilling Jars can be used at any depth. The jars are fully balanced for hydrostatic pressure.

Explanation of Mechanism

The Up Jar's hydraulic operation is built around Bowen's Cone-type piston (See Figure 1 on page 4 and Figure 2, page 5). There are four parts to the Cone assembly: Cone, By-Pass Body, Seal Body and Seal Body Seal. The By-Pass Body and Seal Body are held in place between a shoulder on the Mandrel Extension and the top of the Washpipe. The Cone is free floating for a short distance between the By-Pass Body's upper shoulder and the top face of the Seal Body. As the Mandrel of the Up Jar is pushed downward, "cocking" the tool, the Cone floats upward until it shoulders against the By-Pass Body's upper shoulder, opening a gap between the Seal Body and Cone, and allowing the oil to pass freely around it until the Jar closes and the Mandrel shoulders against the Mandrel Packing Retainer near the top of the tool. When the driller starts to raise the string, the gap between the Seal Body and Cone closes, stopping the flow of oil except for the amount flowing through precision metering grooves on the bottom face of the Cone. As the Mandrel is extending, restricted by the slow flow of oil through the grooves on the Cone, the drill string stretches until the Cone reaches an undercut in the Pressure Body at which time the oil instantaneously moves around the Cone. This allows the drill string to snap upward, like a rubber band, pulling the Mandrel and Mandrel Extension up at a very high speed until the top face of the Mandrel Extension strikes the shoulders of the Splines in the Spline Body. This produces the upward jarring blow.

The Down Jar uses a mechanical detent system which is set before going in the hole at a predetermined trip load (not to exceed the maximum recommended load) which will release when that weight is lowered against the tool (see Figure 1 on page 4 and Figure 2 on page 5). The tool is preset by removing the Control Ring Plug with the Control Ring Plug Wrench, No. 80733. By using the handle of the Plug Wrench or a large screwdriver as a lever through the Plug hole into slots in the Control Ring, the Ring may be turned to adjust the load.

As the string is lowered, the ridges in the tapered Friction Slip catch the ridges on the Friction Mandrel keeping the tool from closing. The ridges on the O.D. of the Friction Slip are offset from those on the I.D. to provide clearance for the I.D. ridges to flex and the Friction Slip to expand. When the load reaches its preset limit, the Friction Slip expands and its I.D. ridges slip past the Friction Mandrel ridges allowing the String and Bowl to rapidly fall and the tool to close. The jarring blow is produced when the shoulder of the Mandrel Packing Retainer strikes the Mandrel shoulder.

The Bowl bore is tapered. When the Control Ring is adjusted all the way down, there is more room between the Friction Mandrel and Bowl so the Friction Slip has to flex less when tripping to produce a light blow. When the Control Ring is adjusted all the way up, there is less room between the Friction Mandrel and Bowl, so the Friction Slip has to flex more when tripping. This produces the maximum jarring blow. The down jar trip load is completely variable up to the maximum rated load.

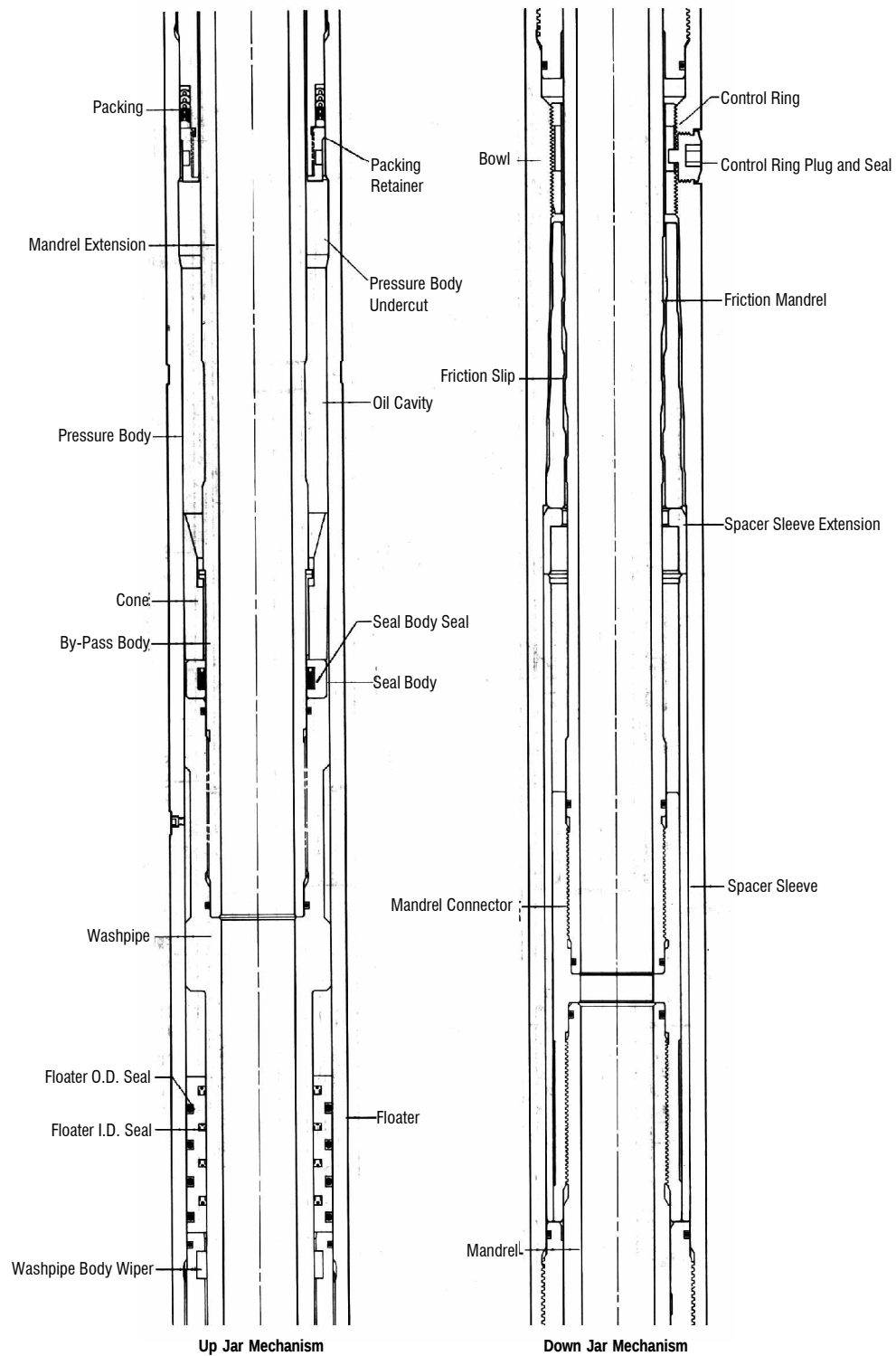


Figure 1

Note: See Figure 2 on page 5 for 9" Up and Down Jar Mechanism
NOTE: Jarring points are not shown.

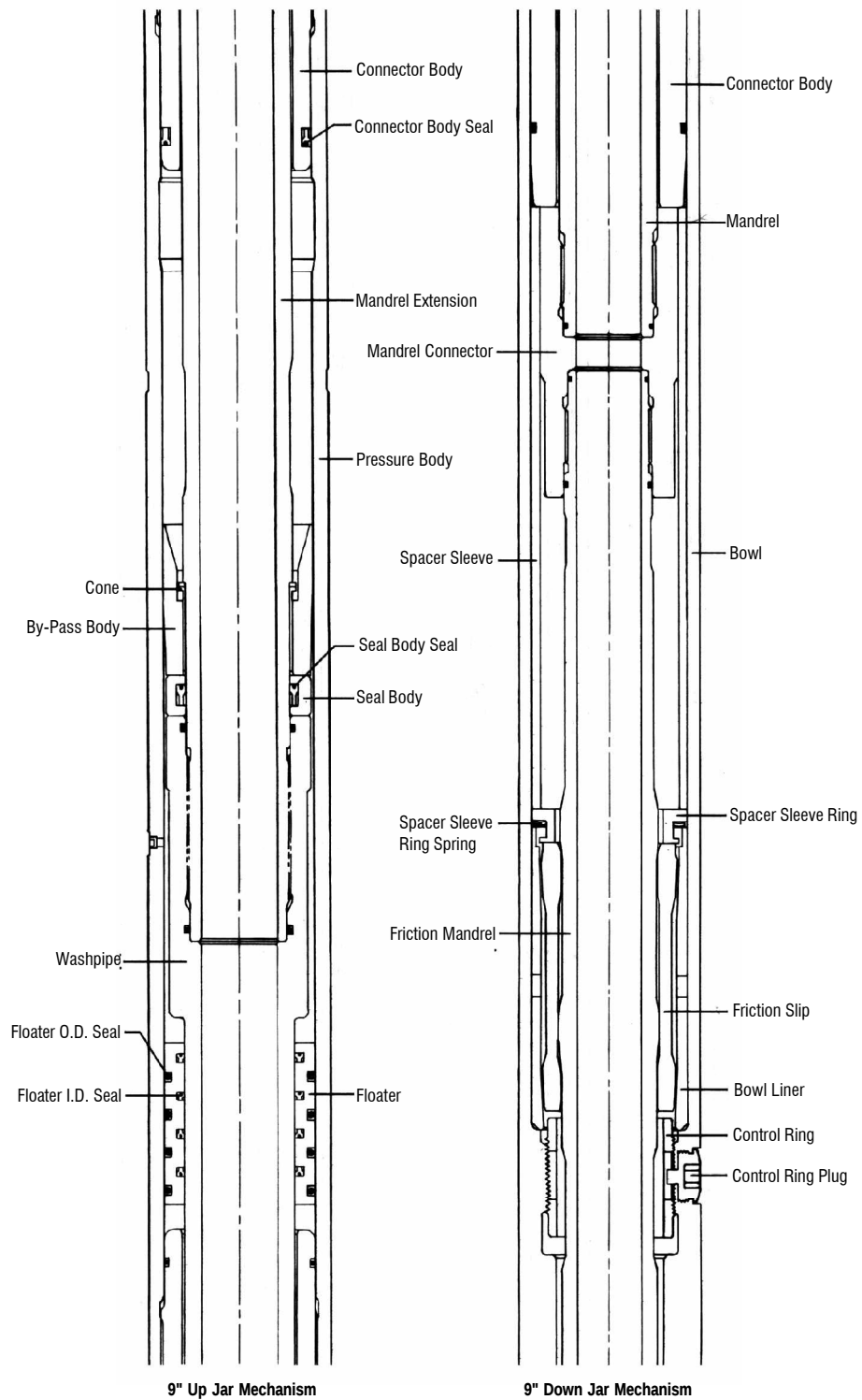


Figure 2

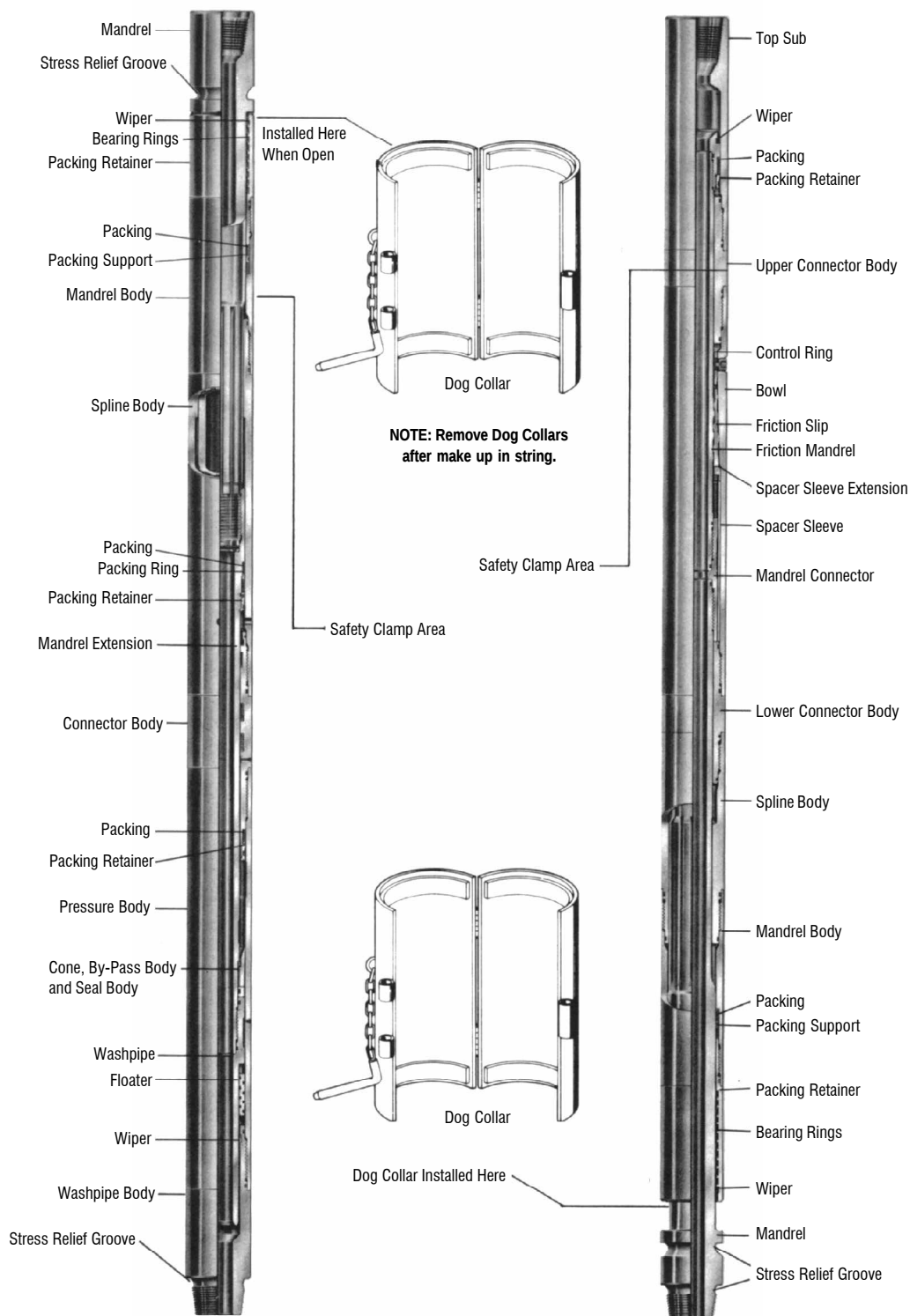


Figure 3
Dog Collar and Safety Clamp Areas

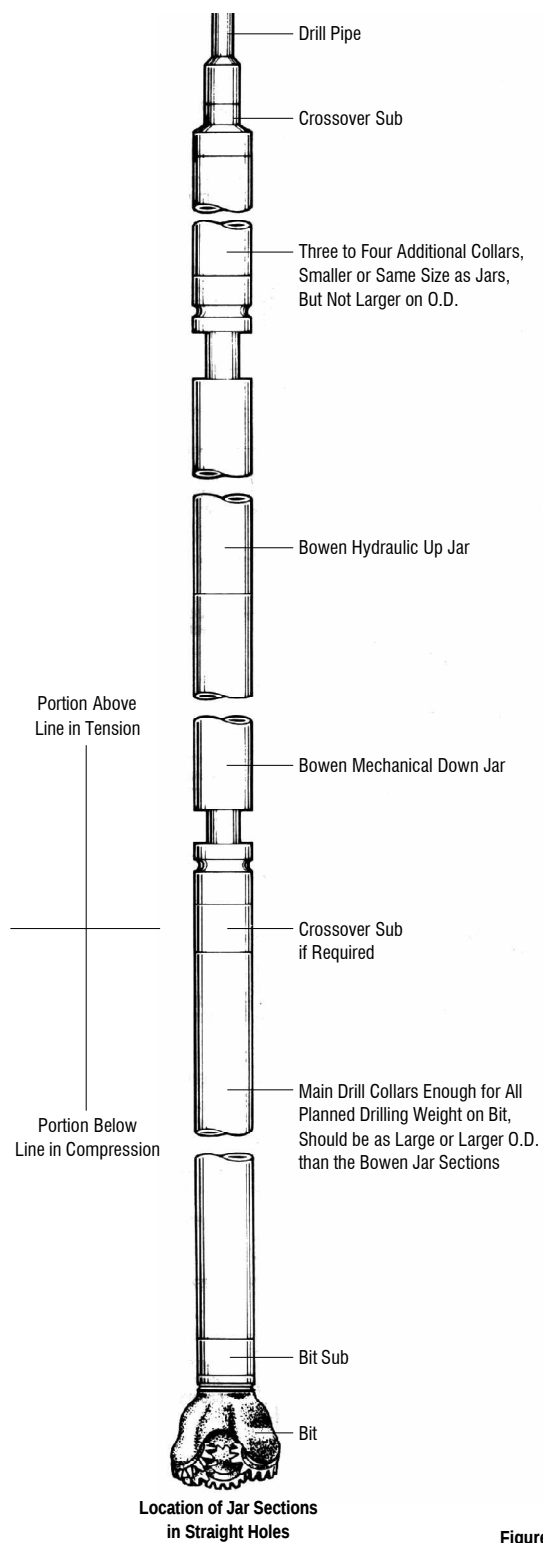
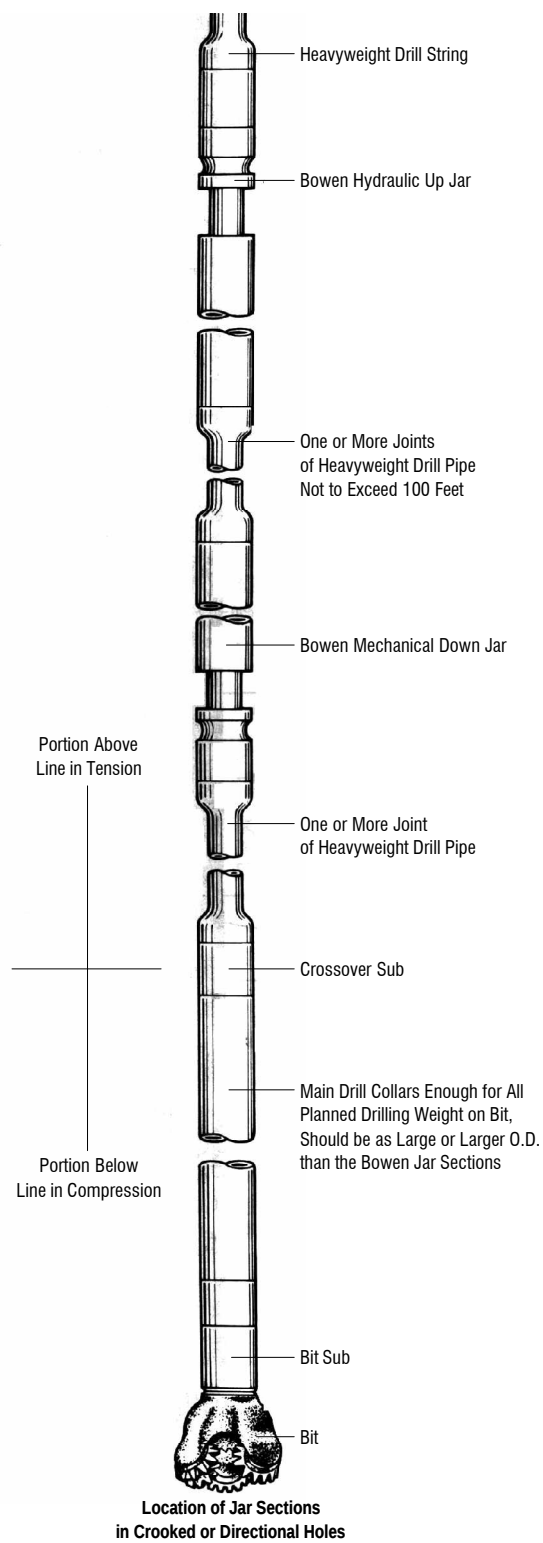


Figure 4



Operation

The Bowen Hydromechanical Drilling Jar will arrive at the rig in two sections. Both sections should be in the open position (Mandrels extended). If the Mandrels are not completely extended they should be carefully pulled open before going into the hole. Dog Collars should be clamped around the exposed Mandrels and should not be removed until the tool is made up in the string. Dog Collars should be reinstalled on the jars when they come out of the hole.

Placement in the String

The Bowen Hydromechanical Drilling Jar is installed with the Up-Jar section located above the Down-Jar section of the tool (see Figure 4 on page 7). In fairly straight holes, it is recommended that the two sections be run as a single unit made up in the drill string just above the main drill collars and with three or four collars or an equivalent weight in heavyweight pipe above the Jar. The collars, or any tools above the Jar, should not exceed the Jar diameter.

In a directional well or a crooked hole, it is suggested that the Jar be run with a joint of heavyweight drill pipe immediately below it to connect it to the drill collars (see Figure 4, page 7). The two section design of the tool allows it to be run with the sections separated and in a directional well or crooked hole it is recommended that they be separated by a joint, but not more than 100 feet of heavyweight pipe. This separation gives added flexibility.

Having selected the location to run the tool in the string, pick up the Down Jar, using a lift sub, and make up in the string. The mechanical Down Jar will arrive at the rig with tripping mechanism preset to a known tripping load. If a different load is desired, the tripping load must be reset before going in the hole.

To adjust the tripping load, remove the Control Ring Plug and using a large screwdriver or the handle of Control Ring Plug Wrench, Part No. 80733, as a lever in the slots of the Control Ring, rotate the Control Ring in the uphole direction to increase the tripping load and in the downhole direction to decrease the tripping load. This Ring has left hand threads. Rotation of one notch will change the tripping load approximately 1,000 to 2,000 lbs. depending on tool size. After adjustment, center the nearest slot in the Control Ring with the hole, coat the threads of the Control Ring Plug with a good grade of thread locking compound and replace it tightly. The preset tripping weight should always be less than the string weight above the tool and should never exceed the tool string limits. See Strength Data on pages 17 and 23. Prior to lowering in the hole pick up on the string and check to see if the Mandrels are completely extended. If they are not they should carefully be pulled open before going into the hole.

The Up Jar section should be handled in the same manner when ready to lower it into the hole. Any safety device such as an O.D. safety clamp, should be positioned as shown on Figures 2 and 3.

CAUTION: Do not handle the tool or repair it for use in any way which would make the sections close. This would cause the Up Jar mechanism to cock and if it should trip while going in or out of the well, it may damage the rig or cause the slips to fail.

The operator should also be aware that any downward "spudding" through a tight area of the well may place the Jar in a cocked position. If such an occurrence is suspected, the slips should be set, the elevators left in place on the pipe, and in hole operations suspended for approxi-

mately 10 minutes. If the Jar was cocked, this will allow the weight of the collars below the Jar to pull it into an open position. A moderate jarring blow may be noticed when this occurs.

The Jar is usually run in tension, however, under certain conditions and following a careful procedure, the Jar may be run in compression.

Drilling

Tension Drilling

When the drill string reaches the bottom, drilling can begin (see Figure 4, page 7). The Jar will normally remain in an open position (both Mandrels extended) while drilling or tripping. The weight of the collars below the Jar plus the pump open effect of mud pressure against the Washpipe area tends to keep it open. When operating, loads must remain within the maximum ratings (see Strength Data on pages 17 and 23).

Compression Drilling

The Bowen Hydromechanical Drilling Jar may be run in compression, provided the load above the jar does not exceed one half the Down Jar setting plus the 'pump open' force (force developed by differential pressure acting across the mandrel area of the Jar). See the charts on page 10 for pump open force. This limitation is recommended to prevent inadvertent jarring down when the bit is on bottom.

To Jar Upward

If the string becomes stuck and upward jarring is needed, proceed as follows:

1. Lower string until slightly more weight than the operator feels is necessary to overcome string friction in the hole shows on the weight indicator. A very minimal slack-off is needed to cock the Jar. (Normally 8,000 to 12,000 lbs. over string weight).

2. Raise the string to trip. The jarring force is infinitely variable depending on drawworks speed. Some operators start with moderate forces and increase each time until the string breaks loose. (See Specifications for Maximum Recommended Jar Load on page 17.) Do not pull forces more than the string weight above the Jar plus the maximum Up Jar trip load.
3. If the first pull fails to trip the Jar, slack off may not have been enough to cock it. Lower the string again and slack-off further on the weight indicator.

To Jar Downward

When jarring down is necessary, proceed as follows:

1. The Down Jar is normally extended and in a cocked position when tripping and drilling. To deliver a downward force, lower the string until the weight exceeds the preset tripping load plus the pump open force (if circulating) across the mandrel, and the Jar will trip.
2. To recock the Down Jar, raise the string until a load slightly greater than the string weight above the Jar is indicated.

NOTE: When a down load is placed on the Down Jar, the Up Jar automatically cocks. Therefore, do not pull a load heavier than necessary or delay too long when cocking the Down Jar because the Up Jar may trip causing adverse effects to the jarring operation.

3. The above steps may be repeated as often as necessary to free the string.

Load Calculations

It is common practice to calculate the weight of the string above the Drilling Jars, add the desired jarring pull to the string weight, and assume that the correct jarring pull has been established. In fact, there are many factors which affect the load that is actually delivered to the Jar and make it appear to trip at a different load than indicated at the surface. The most significant factors are friction drag, weight indicator error, and "pump open" effect if circulating while jarring.

Friction drag is usually minor in shallow straight holes; however, in deep, crooked holes, the increase in friction drag when stuck can be substantial and must be considered when calculating pull loads for jarring. The additional tensile load placed in the string by jarring pulls will cause the string to bear heavily against doglegs in the hole, with a resulting increase in friction. The following examples illustrate the result of increased friction, when tripping an up jar.

Straight Hole Conditions

Weight above Jars = 262,000 (weight indicator reading) - 18,500 (weight below Jars) = 243,500.

Pull to trip Up Jar = weight above Jars + desired jarring effect + weight indicator error + increased friction = 243,500 + 120,000 + 6,000 + 5,000 = 374,500 lbs.

Crooked Hole Conditions

Weight above Jars = 262,000 (weight indicator reading) - 18,500 (weight below Jars) - 30,000 lbs. (friction) = 213,500 lbs.

Pull to trip Up Jar = Weight above Jars + desired jarring effect + weight indicator error + increased friction = 213,500 + 120,000 + 6,000 + 45,000 = 384,500 lbs.

The foregoing examples illustrate the difference in pull loads under different hole conditions even though the desired jarring effect and string weight indicator reading remained the same. The friction factor and weight indicator reading were assumed and obviously will vary widely. The operator must rely on his experience and knowledge of hole conditions to choose an appropriate factor. Down Jar operations are affected in a similar manner.

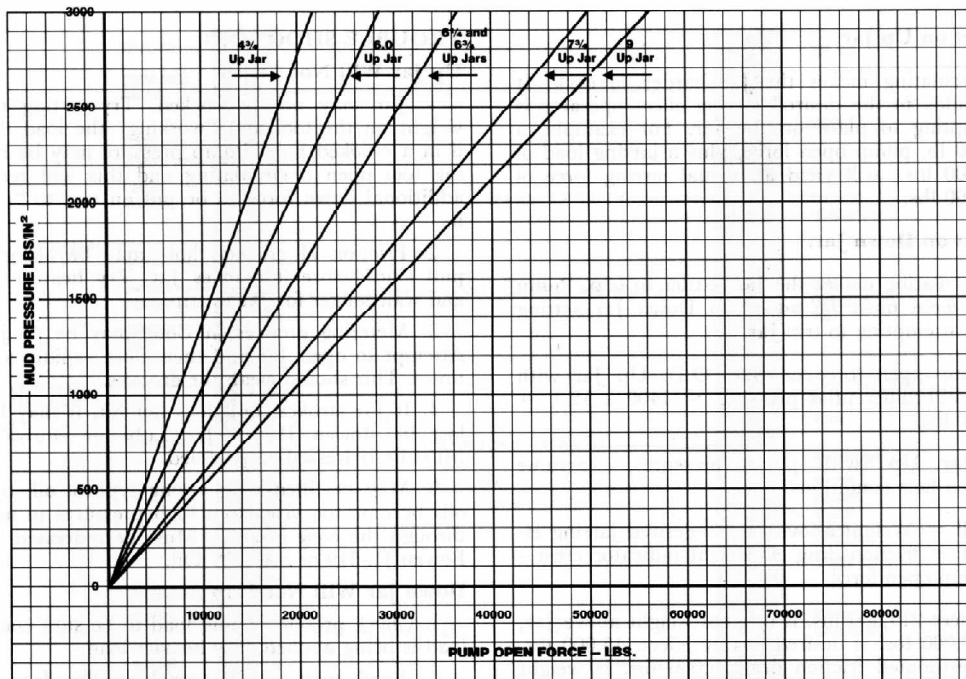
The pump open force is that force developed by differential pressure acting on the Mandrel or Washpipe areas of a downhole tool. Its effect is a tendency to pump the tool open.

Pump Open Areas

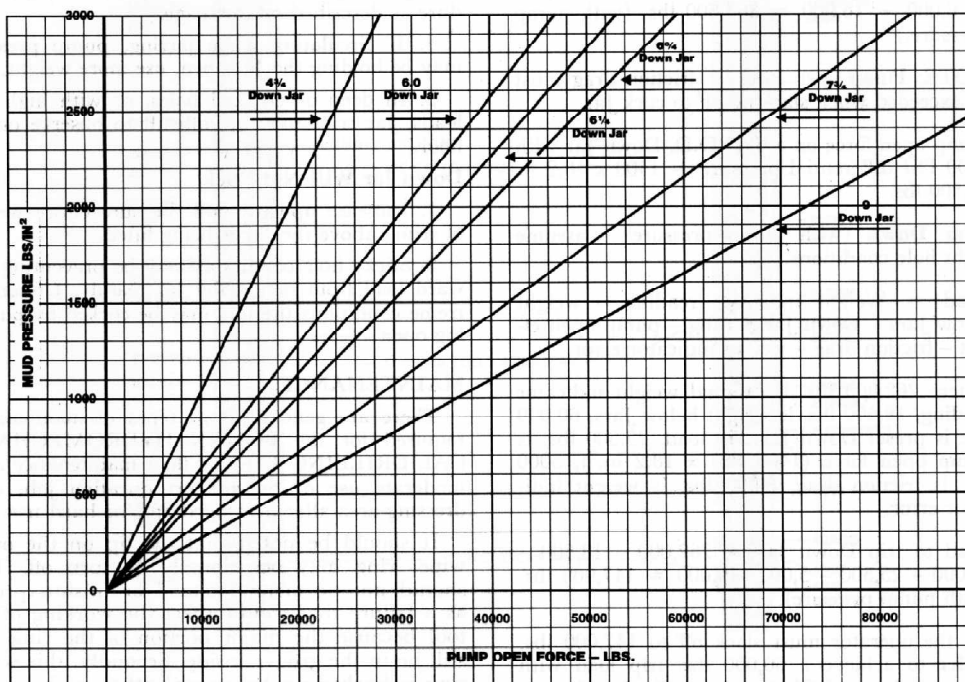
Jar O.D.	Type Jar	Area – in ²
4-3/4"	Up Jar	6.5
	Down Jar	9.6
6"	Up Jar	9.6
	Down Jar	15.9
6-1/4"	Up Jar	12.1
	Down Jar	18.2
6-3/4"	Up Jar	12.1
	Down Jar	19.7
7-3/4"	Up Jar	16.8
	Down Jar	28.3
9"	Up Jar	19.2
	Down Jar	37.1

Effect on Up Jar

Circulating makes the Jar harder to cock. It also adds to the desired jarring effect operator is attempting to place on the Jar. For example, a 30,000 lb. pump open force, plus a jarring load of 100,000 lbs., will yield an actual jarring force of 130,000 lbs.



Up Jars - Mud Pump Pressure vs Tool Pump Open Force



Down Jars - Mud Pump Pressure vs Tool Pump Open Force

Effect on Down Jar

Circulating makes the Jar harder to trip. Pump open force must be added to Down Jar setting when attempting to trip Jar.

Pump open force on 6-1/4" O.D. Up Jar with ,1400 psi differential pressure = $1,400 \times 12.1 = 16,900$ lbs.

To Jar Up (with Pump Pressure)

Assume crooked hole conditions.

Pull = Weight above Jar + desired jarring effect + friction drag + weight indicator error – pump open force.

Where 213, 500 lbs. is original weight above Jar, 120,000 lbs. is desired jarring effect, 45,000 lbs. is estimated friction drag, 6,000 lbs. is weight indicator error (5% of 120,000 lbs.), 16,900 lbs. is pump open force ($1,400 \text{ psi} \times 12.1 \text{ in}^2$).

Therefore Pull = $213,500 + 120,000 + 45,000 + 6,000 - 16,900 = 367,600$ lbs. (with pump pressure.)

NOTE: Pump open force + friction drag must be exceeded when slacking off to cock Jar.

Pump open force on a 6-1/4" O.D. Down Jar with 1,400 psi differential pressure = $1,400 \times 18.2 = 25,500$ lbs.

To Jar Down (with Pump Pressure)

Assume straight hole conditions.

Load = Weight indicator reading – weight below Jars – Down Jar Setting – pump open effect – friction drag – weight indicator error.

Where 262,000 lbs. is original weight indicator reading, 18,500 lbs. is weight below Jars, 60,000 lbs. is present Down Jar trip load, 25,500 lbs. is pump open force ($1,400 \text{ psi} \times 18.2 \text{ in}^2$), 5000 lbs. is friction drag, 6,000 lbs. is weight indicator error.

Load to trip Down Jar = $262,000 - 18,500 - 60,000 - 25,500 - 5,000 - 6,000 = 147,000$ lbs. (with pump pressure).

Thus, the operator must slack off to 147,000 lbs. in order to achieve a 60,000 lbs. trip load with pumps running and friction drag affecting the operation.

Troubleshooting

Up Jar Will Not Trip

1. Jar may not be cocked. Try setting more weight on the tool and "working" the load down if in a crooked hole. Pump pressure may be holding tool open if circulating and this will require additional down force to be put on tool to "cock" it.
2. Friction of crooked hole may be absorbing pull load before it reaches Jar. Try heavier load and wait longer for Jar to trip.
3. Metering grooves in Cone may be plugged. Attempt to open Jar and then close rapidly a few times. This should clean the grooves.
4. If Jar strokes, but does not hit, it may have lost its Bowen JL-519 Jar Lube or equivalent. Must be redressed and refilled.
5. May be filled with wrong type of oil. Some oils become too viscous at high pressures to meter through the cone grooves. Must be redressed with Bowen JL-519 or SA 10W Oil.

Down Jar Will Not Trip

1. Check preset tripping load to be sure enough load is being applied. Try heavier load.
2. Load may not be reaching the Jar. Try "working" the load down if hole is deep or crooked.
3. Jar may not be cocked. Repeat cocking procedure as described on this page.

4. If circulating while jarring, pump pressure may be holding the Jar open, use more weight.
5. In deep or crooked holes, or with high trip loads, Jar trips may be difficult to observe on rig floor.

Down Jar Will Not Cock

1. Increase upward pull. Be sure entire weight of string above the Jar is being lifted.
2. Sticky hole conditions may be preventing upward load from racing the Jar readily. Under extreme conditions the tool may be cocked by pumping open.

Maintenance

There are generally two types of maintenance required for the Bowen Hydro Mechanical Drilling Jar; rig floor maintenance after moderate use or on a short duration job, and; dressing area after prolonged and/or hard use. It should be noted that the lip on the outer wiper ring may occasionally be torn off. This should not be misunderstood or misinterpreted as a failure that would affect the working of the tool because the major portion of the ring will still be in the groove inside. Secondly, this wiper ring is backed up by several other rubber rings to allow for this damage.

Rig Floor Maintenance

After moderate use and when the Jar is to be kept at the rig site, pull the tool through the rig floor and wash all mud from the exterior of the Jar Sections. (Avoid any action which could cock the Up Jar.) Flush all mud from Mandrels, Washpipe, and Washpipe Body. There is one area near the bottom of the Up Jar Spline Body where vent hole openings to the interior are necessary. Entrance of mud and well fluids to this area cannot be avoided, but thorough flushing after use is required. Place the wash down hose nozzle in one vent hole and flush

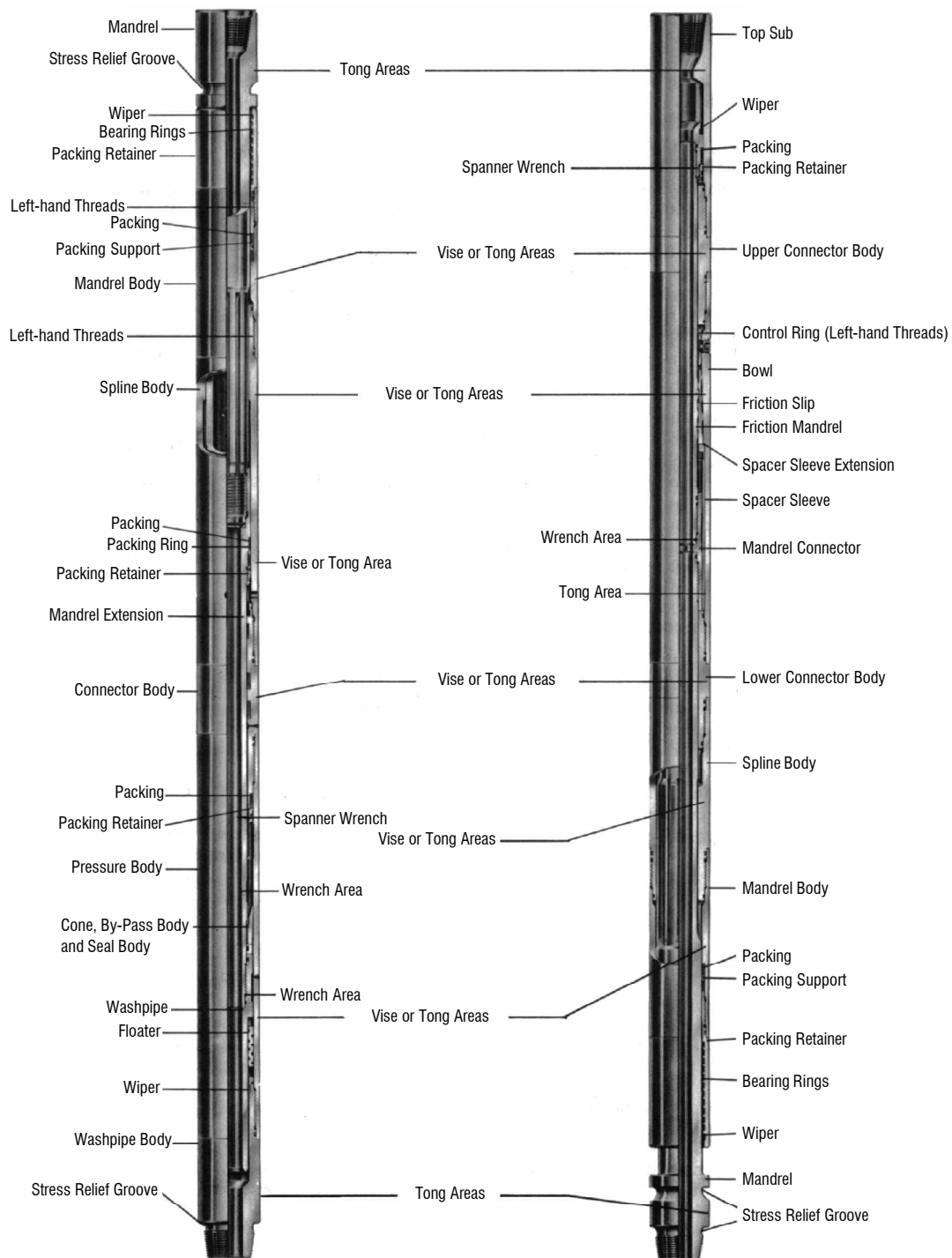


Figure 5
String Make-Up and Maintenance Tong,
Vise, and Wrench Areas

one direction and then place it in another vent hole and flush the other direction. Repeat until clean water begins to emerge. Spray inside of chamber with water displacing oil, if available.

If the tool is to be run again, it may be "racked" with the drill collars or heavy-weight pipe. Be sure to put Dog Collars on the Jar. If the tool is to be laid down, prior to storage, coat pin and box threads with high quality thread lubricant and put thread protectors on tool joints. The tool should be stored horizontally and sprayed with a light oil to keep rust off surfaces such as the Mandrels.

Dressing Area Maintenance

After prolonged and /or hard use, the Bowen Hydromechanical Drilling Jar should be taken to an adequate dressing area to be completely disassembled, cleaned, inspected, repaired as required and reassembled. It is recommended the tool be serviced at intervals not to exceed 30 days or 500 hours running time or between jobs. If heavy jarring has been done, the tool should be serviced as soon as possible.

The following list of tools and pieces of equipment should be obtained before starting maintenance:

- (1) Bowen Vise or equivalent (suitable for the tool size)
- (1) Overhead Crane (2,000 lb. minimum capacity)
- (1) Bowen Tong or Rig Tong (suitable for the tool O.D.)
- (2) Pipe Wrenches (suitable for the O.D.s of interior tool parts)
- (2) Adjustable Support Stands with rollers (or a pulley and belt system which can be suspended from the crane for spinning off/on threaded parts)
- (1) Adjustable Spanner Wrench Bowen Part No. 77217
- (1) Control Ring Plug Wrench Bowen Part No. 80733
- (1) Fill Plug Wrench Bowen Part No. 359
- (1) Fill Plug Wrench Bowen Part No. 620
- (1) Seal Removal Tool Bowen Part No. 625
- (1) Snap Ring Pliers Bowen Part No. 77216
- (1) Jar Lube Pump Bowen Part No. 2580 (with fittings)
- (1) Packing Assembly Sleeve (suitable for the tool size)
- (1) Bowen Jar Tester

To prevent damage during all servicing, do not use Tong, Wrench or Vise over Fill Plug or Control Ring Plug holes.

Disassembly of Up Jar Section

NOTE: For disassembly or reassembly, the UP Jar should be in the open position, Mandrel exposed, so that Cone in the free area. If not, put in Jar Tester and open before servicing.

1. Using crane, place Up Jar in Vise with Mandrel extended so that it clamps about 15 inches above lower end of Pressure Body, or just below fill plug in middle of Pressure Body. Coat Washpipe Body pin threads with Bowen Itcolube (anti-gall compound) and make up thread protector to pin. Then use Tong to remove Washpipe Body. (Refer to Figure 5 on page 12 for safe areas to use Vise, Tongs, or Wrenches.)
2. Reposition in Vise to clamp on Connector Body. Place pan to catch hydraulic oil under Pressure Body joint. Using Tong, break out Pressure Body and let oil drain, then slide it off over the Washpipe. The Floater will tend to follow the Pressure Body, so when it is off, it is usually possible to reach inside and pull the Floater out the bottom. If the Floater has slid up, a long board may be used to push it out the bottom from the other end. The Floater seals may be removed using Bowen Part No. 625 or screwdriver with its tip bent at about an 80 degree angle.

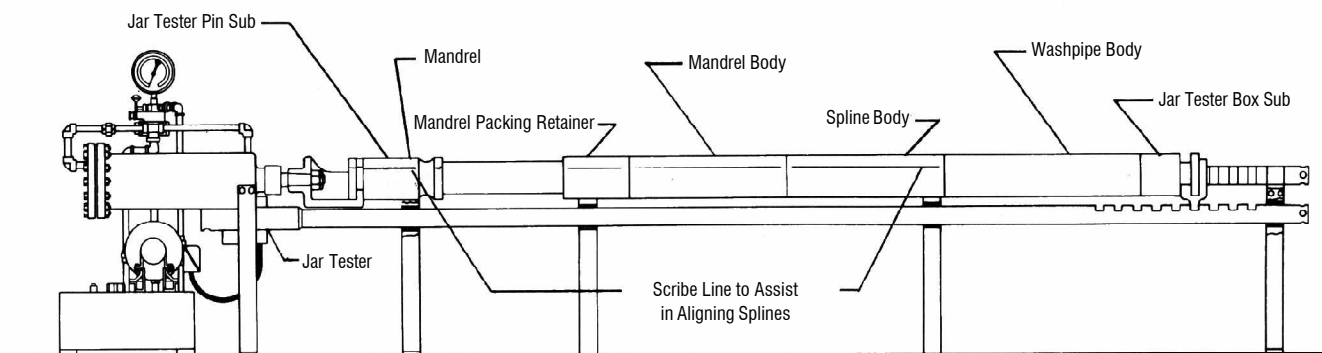


Figure 6
Jar Tester Set Up for (Pulling) Mandrel from Body Parts
or (Pushing) it Back in to Body Parts

3. Place pipe wrench on undercut wrench area at upper end of Washpipe, and begin to break connection. If Mandrel Extension begins unthreading from Mandrel, cease wrenching until Mandrel Extension can be held back by other pipe wrench on undercut wrench area at its bottom end. Then remove Washpipe, Seal Body, Cone, and By-Pass Body. Handle the Seal Body, Cone and By-Pass Body carefully and wrap them in cloth when removed.

4. Using spanner wrench, remove Connector Body Lower Packing Retainer and Packing.

NOTE: On 4-3/4 and 6 inch tools, use Step 5a, skip Step 5b, then proceed to Step 6. On 6-1/4 and 7-3/4 inch tools, skip Step 5a and proceed with Steps 5b and 6.

5a. The 4-3/4 and 6-inch size tools have a two-piece Connector Body. They are the Connector Body and Connector Body Adapter. On these tools, reposition in Vise to clamp above the next joint on the tool (the joint between the Connector Body and Connector Body Adapter). Place Tong just above Connector Body Adapter Fill Plug hole and remove Adapter. The Connector Body Middle Packing Sets and Packing Supports should come off with the Adapter and may be removed using tool No. 625 or a bent screwdriver. Reposition in Vise to clamp above vent holes in Spline Body. Using Tong, remove Connector Body.

5b. For 6-1/4 and 7-3/4 inch sizes, reposition tool in Vise to clamp a few inches above vent holes of spline Body and using Tong, remove Connector Body from Spline Body. Middle Packing sets may be removed with No. 625 tool or bent screwdriver.

6. Using pipe wrench on undercut wrench area of Mandrel Extension, (where sometimes held back when removing Washpipe), break out and remove Mandrel Extension. (The Mandrel Extension joint is inside lower end of Spline Body.) After removal, use Snap Ring Pliers, Part No. 77216, to remove Packing Retainer Ring. Pick up Washpipe Body, remove both O-Ring Seals and Wiper and make up hand tight into lower box thread of Spline Body.

7. Put a Jar Tester subs in Mandrel Box and on pin of Washpipe Body, remove tool from Vise and place tool in Jar Tester. Using straight edge, scribe line along length of tool from end of Mandrel Box connection across Mandrel, Packing Retainer, Mandrel Body and to bottom end of Spline Body (this is to assist in aligning the Splines during reassembly of tool). Set Tester a low pull, 4,000 to 6,000 lbs., and pull Spline Body. Mandrel Body and Packing Retainer off Mandrel in one section. Be careful to support ends of Mandrel and Body Parts as they are pulled apart (see Figure 6 on page 13).

8. Reposition Body parts in Vise to clamp on Mandrel Body and, using Tong, remove the Mandrel Packing Retainer.

NOTE: This joint has left-hand threads.

9. Reposition in Vise to clamp on upper end of Spline Body and using Tong, remove Mandrel Body.

NOTE: This joint has left-hand threads.

10. Remove all O-Rings, Wipers and packing from all parts and thoroughly clean them. Look carefully for any galled areas or worn portions which may need to be replaced. Remove Fill Plugs from tool.

On parts of both Up Jar and Down Jar the following inspection and minor repairs may be made:

1. Carefully clean all the disassembled parts with solvent and wipe them dry with a lint free, clean cloth.
2. Check all the parts for defects. Examine all polished surfaces for pits and scratches. Any abrasions on these surfaces will damage the Packing and O-Ring seals, resulting in loss of fluid or pressure during the operation of the tool. Any rough, shallow pits, or burrs, may be removed by use of fine emery cloth. Parts with major pits or deep scratches and grooves must be replaced.
3. Check the splines on the Mandrels and in the Spline Bodies for burrs or upsets. These may be carefully ground away with a grinder or a small hand file and afterwards polished with emery cloth.
4. Examine the bores of the Connector Bodies and Mandrel Bodies for signs of scratches or galls. Minor damage of this nature may be smoothed out with emery cloth, or if very minor, may be disregarded. Any deep scratches in the smooth bore of these parts will render them unfit for further service.
5. Up Jar. Carefully examine the Cone. Polish off any abrasions, nicks, galls or burrs at the O.D., I.D., or face. Use a small hand file or emery cloth carefully, because these surfaces are ground. Any damage to the Cone, By-Pass Body or Seal Body surfaces will render them unusable.

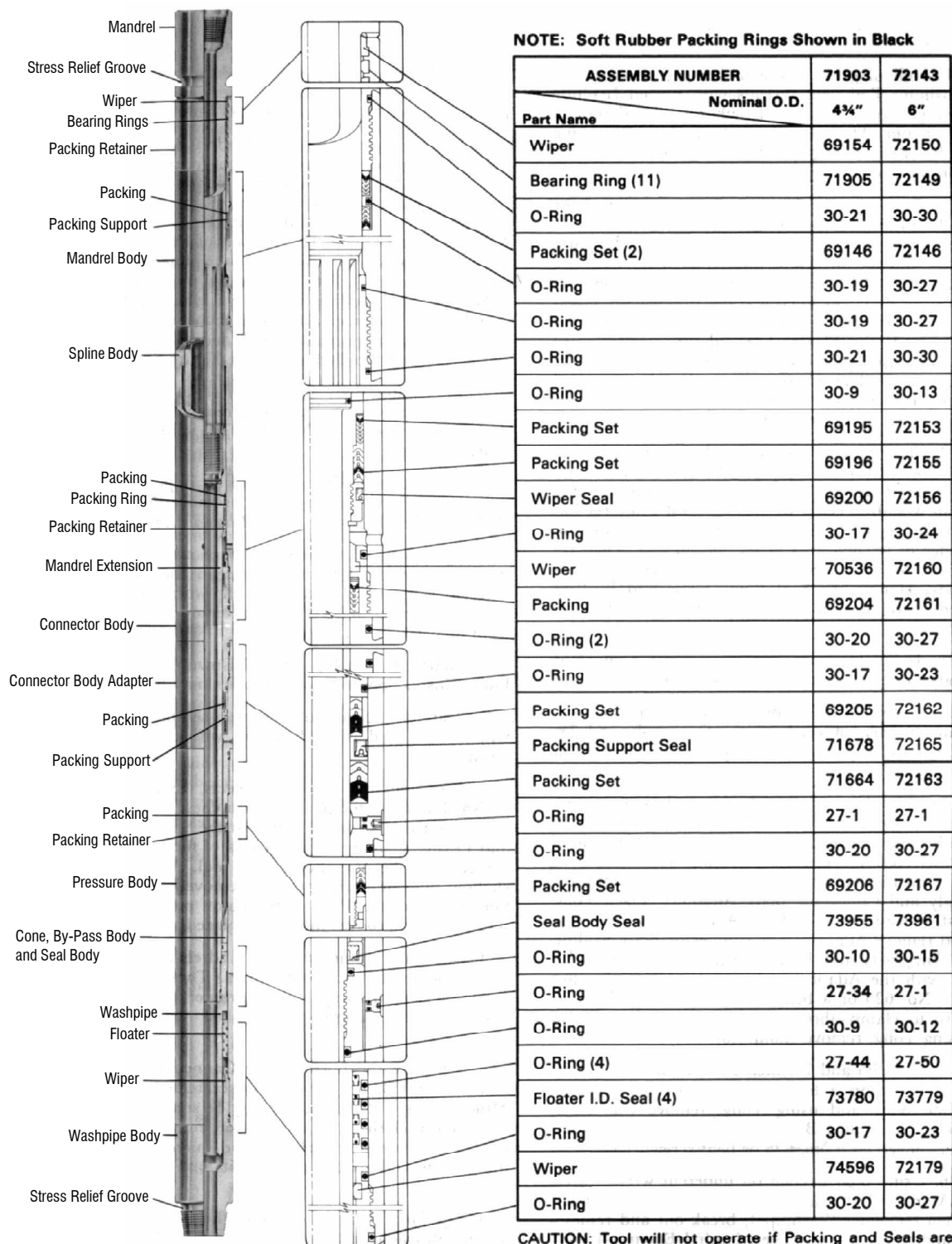


Figure 7
4-3/4" and 6" Up Jar
Packing, Wiper, Ring, and Seal Reassembly Guide

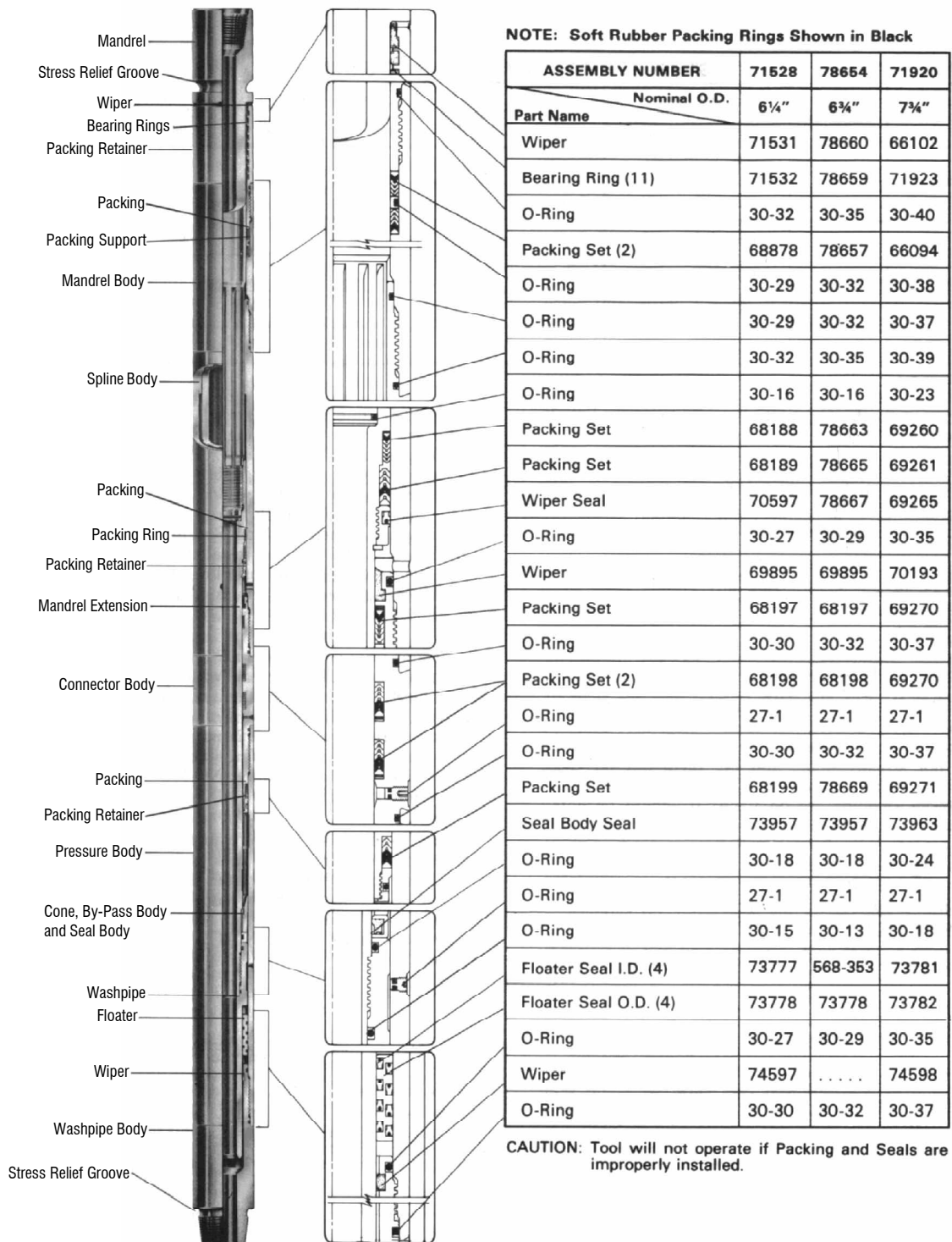


Figure 8
6-1/4" and 7-3/4" Up Jar
Packing, Wiper, Ring, and Seal Reassembly Guide

Hydraulic Up Jars Strength Data

Assembly Part No.	Diameter (inches)		Threaded Connection	Lift Load After Jarring (tons*)	Maximum Recommended Jar Load (tons*)	"Low" Pull Load (tons*)	Standard Test Load (tons*)	Lowest Allowable Test Load (tons*)	Full Stroke Length (inches)
	Outside (Nominal)	Inside							
102072	9"	3-1/16"	7-5/8" Reg.	955	250	20	50	50	14
71920	7-3/4"	3-1/16"	6-5/8" Reg.	663	150	15	50	40	14-1/2
78654	6-3/4"	2-1/2"	5-1/2" Reg.	468	110	12	50	40	13-1/2
71528	6-1/4"	2-3/4"	4-1/2" I.F.	400	85	10	50	35	13-1/2
72143	6"	2-1/4"	4-1/2" F.H.	400	85	8	45	30	13-1/2
71903	4-3/4"	2"	3-1/2" I.F.	273	50	5	25	15	12

*2,000 lbs. per ton

- Down Jar. Examine the Friction Slip, Friction Mandrel, and Bowl I.D. for signs of peripheral cracks and damage. They must be replaced if such defects appear.
- Carefully check the tool joint threads for nicks, or burrs, removing any found. Then thoroughly oil all the parts with a good grade of light, clean oil.

Reassembly of Up Jar Section

Prior to reassembly, the parts should all be thoroughly cleaned and dried. Make sure all parts are in good condition. Coat them with a thin oil, if not already done, and lay them out on clean cloths or kraft paper. Be sure three or four lbs. of Bowen Itcolube are on hand. It should be noted that no other lube is satisfactory for this tool in areas of severe friction and bearing loads such as the splines. All threaded connections should be coated with Itcolube prior to making up. An adequate supply of cup grease and a small amount of Bowen Jar Lubricant should also be on hand.

The tool will normally require a complete set of packing each time it is redressed. The complete packing set consists of Packing, O-Rings, Bearing Rings, Wipers, and Polypak Seals. All these may be installed onto or into Packing Supports and other parts (except for the Washpipe Body which will be used to assist in

reassembly) prior to making up the main parts. Then Packing Retainers and Retainer Rings should also be installed. See Figures 7 and 8 for a guide to installing Packing and Polypak Seals properly. If they are installed backward, the tool will not operate.

- Clamp Spline Body in Vise immediately below up end threads. The end with splines is the up end and the end near the vent holes is the down end. Coat splines of Spline Body generously with Bowen Itcolube. (There is no way to add Itcolube after assembly.) Using Tong, make up Mandrel Body to Spline Body.

NOTE: This joint has left-hand threads.

- Reposition in Vise to clamp on Mandrel Body. Install Mandrel Body Packing Support with its Packing and O-Ring into the up end of the Mandrel Body. Spread some cup grease on the Packing. Using Tong, make up Mandrel Packing Retainer to Mandrel Body.

NOTE: This joint has left-hand threads.

- Coat splines on Mandrel lightly with Bowen Itcolube. The lines scribed along the Body parts prior to disassembly (see Up Jar Disassembly Step 7) may or may not now be realigned. If they are not realigned, which is most likely, align a straight edge with the scribed line on the Spline Body so that a new line can be

struck along the Mandrel Body and Mandrel Packing Retainer. Spread some cup grease on the Wiper and Bearing Rings of the Retainer.

- Pick up Washpipe Body and make up hand tight into lower box thread of Spline Body. Using crane, lift Mandrel and start inserting its down end through Wiper in Mandrel Packing Retainer, aligning scribed line on Mandrel with line scribed along Body parts, until splines begin to engage. Continue to carefully insert until splines disappear behind Wiper and polished diameter of Mandrel begins to enter.
- Install Jar Tester subs in Mandrel box and on pin of Washpipe Body. Place tool in Jar Tester and set Tester to push 4,000 to 6,000 lbs. Continue pushing until Mandrel is completely inserted.
- Remove tool subassembly from Jar Tester and place in Vise to clamp on Spline Body a few inches above vent holes. (Leave Jar Tester Subs installed until after filling and testing.) Remove Washpipe Body, install its Wiper and O-Rings, and set it aside. Place Mandrel Extension up end, with its Packing, Packing Ring, Retainer, Seal and Retainer Ring installed, inside down end of Spline Body. (The Mandrel Extension joint is inside lower end of Spline Body.) Using pipe

wrench on undercut wrench area of Mandrel Extension, make up connection. (If burrs are kicked up on undercut area by pipe wrench during make up, file them down and wipe clean before installing next parts.) Coat the Assembly Sleeve with cup grease and slide it up over end of Mandrel Extension until it is against the By-Pass Body Shoulder on the Extension.

NOTE: On 4-3/4 and 6 inch size tools, use step 7a, skip step 7b, then proceed to step 8. On 6-1/4 and 7-3/4 inch tools, skip step 7a and proceed with step 7b and 8.

7a. The 4-3/4 and 6 inch size tools have a two-piece Connector Body. They are the Connector Body and Connector Body Adapter. On these tools, pick up Connector Body, slide it up over Mandrel Extension, and using Tong, make it up to Spline Body. Reposition in Vise to clamp on Connector Body. Slide Connector Body Adapter Packing Support with its Packing and Polypak Seal up over Mandrel Extension to Connector Body. Pick up Connector Body Adapter and slide it up Mandrel Extension, and using Tong slightly above Fill Plug hole, make it up to Connector Body. Reposition in Vise to clamp on

Connector Body Adapter slightly above Fill Plug hole. Remove Packing Assembly Sleeve and return it to storage.

7b. For 6-1/4 and 7-3/4 inch sizes, slide Connector Body up Mandrel Extension and using Tong slightly above Fill Plug hole, make it up to Spline Body. Reposition tool in Vise to clamp on Connector Body slightly above Fill Plug hole. Remove Packing Assembly Sleeve and return it to storage.

8. Install By-Pass Body, Cone and Seal Body onto Mandrel Extension. Pick up Washpipe and using pipe wrench, make it up to Mandrel Extension. Using crane, pick up Pressure Body and slide it up over Washpipe and using Tong, make it up to Connector Body Adapter (or Connector Body).

9. Reposition tool in Vise to clamp on Pressure Body a few inches below Fill Plug hole. Coat Floater with Bowen Jar Lubricant JL-519 and squirt some up inside the cavity between the Washpipe and the Pressure Body. Slide Floater up over Washpipe until it passes two or three inches of threads in the lower box connection of the Pressure Body.

10. Using crane, pick up Washpipe Body and using Tong (next to joint shoulder) make up to Pressure Body. As this joint is made up, the Floater is pushed into the proper position for starting operation.

NOTE: The Mandrel should not be opened or closed until it is filled with Jar Lube. Remove the tool section from the Vise. It is now ready for filling.

Filling the Up Jar

In the Up Jar, the Floater is automatically positioned and the Mandrel should not be opened or closed until the process of filling the Section with Jar Lube is completed and all Fill Plugs are inserted.

Remove the Fill Plugs. Rotate Section until the plug hole on Connector Body or Connector Body Adapter is pointing upward. This is an air bleed hole. The Fill Plug port on the lower end of the Pressure Body may be in any position. Tilt tool at least 10 degrees with the box or up end two or three feet above the lower end. Resting the up end in an open Vise is suitable. Connect one end of the Exhaust Hose (with fittings) to the air bleed hole and place the other end into the hole in the top of the Jar Lube Pump (this hose is clear plastic for the flow of lube to be observed). Load the Jar Lube

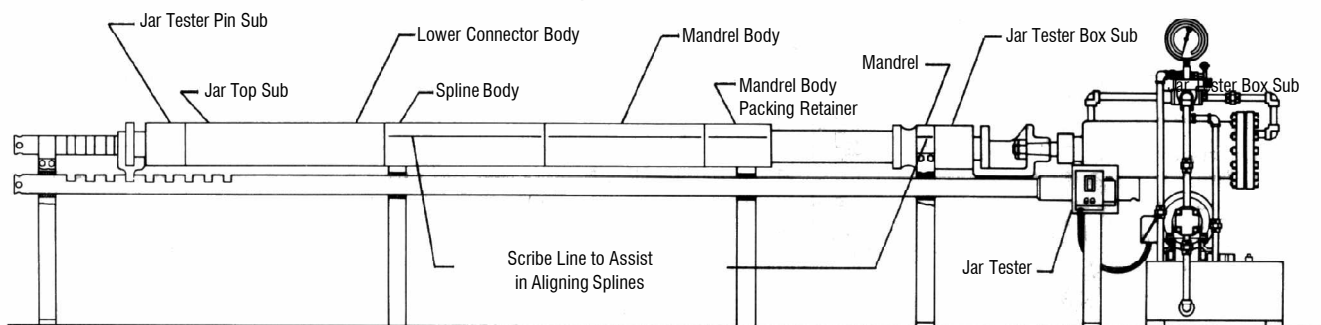


Figure 9
Jar Tester Set Up for (Pulling) Mandrel from Body Parts
or (Pushing) it Back in to Body Parts

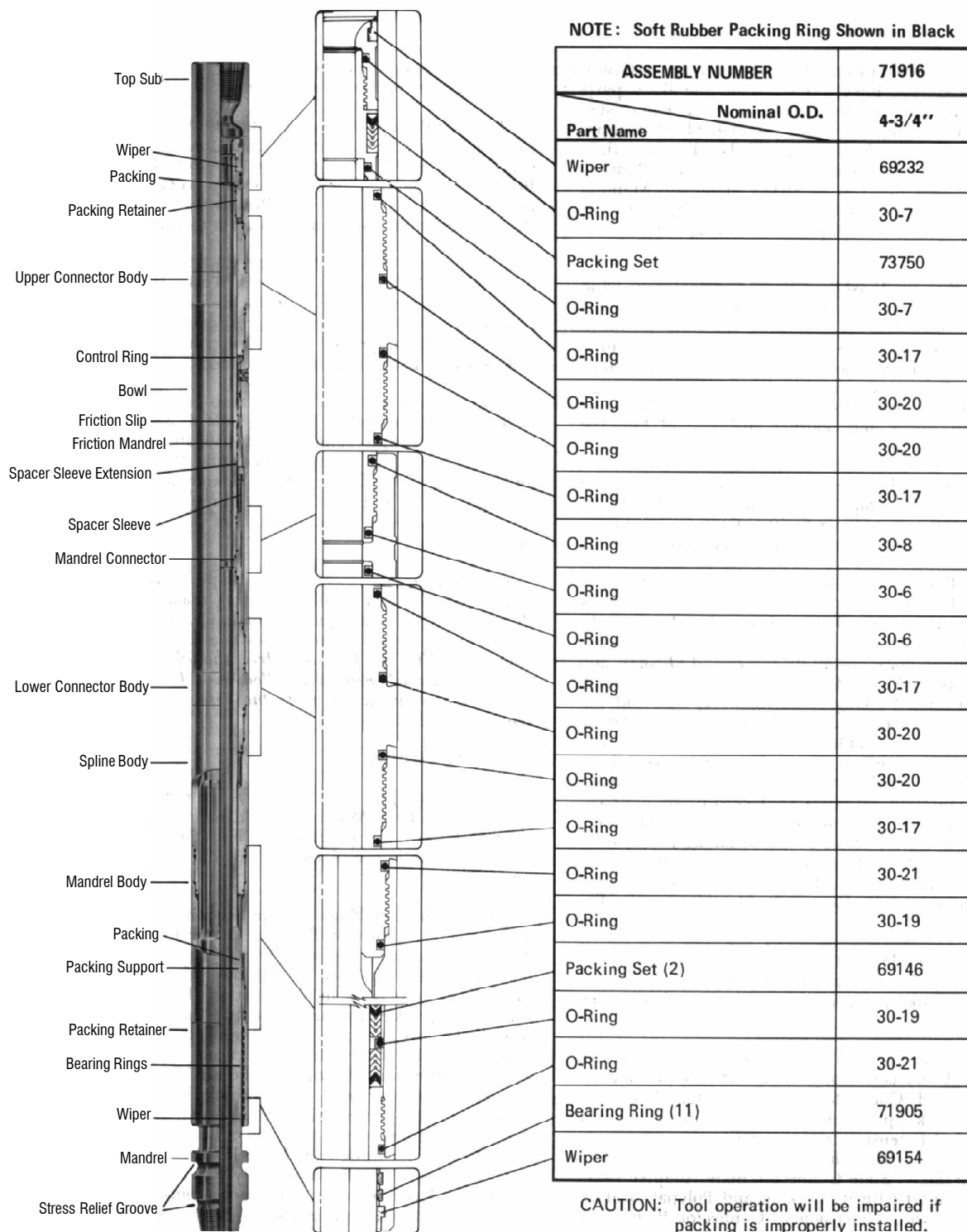
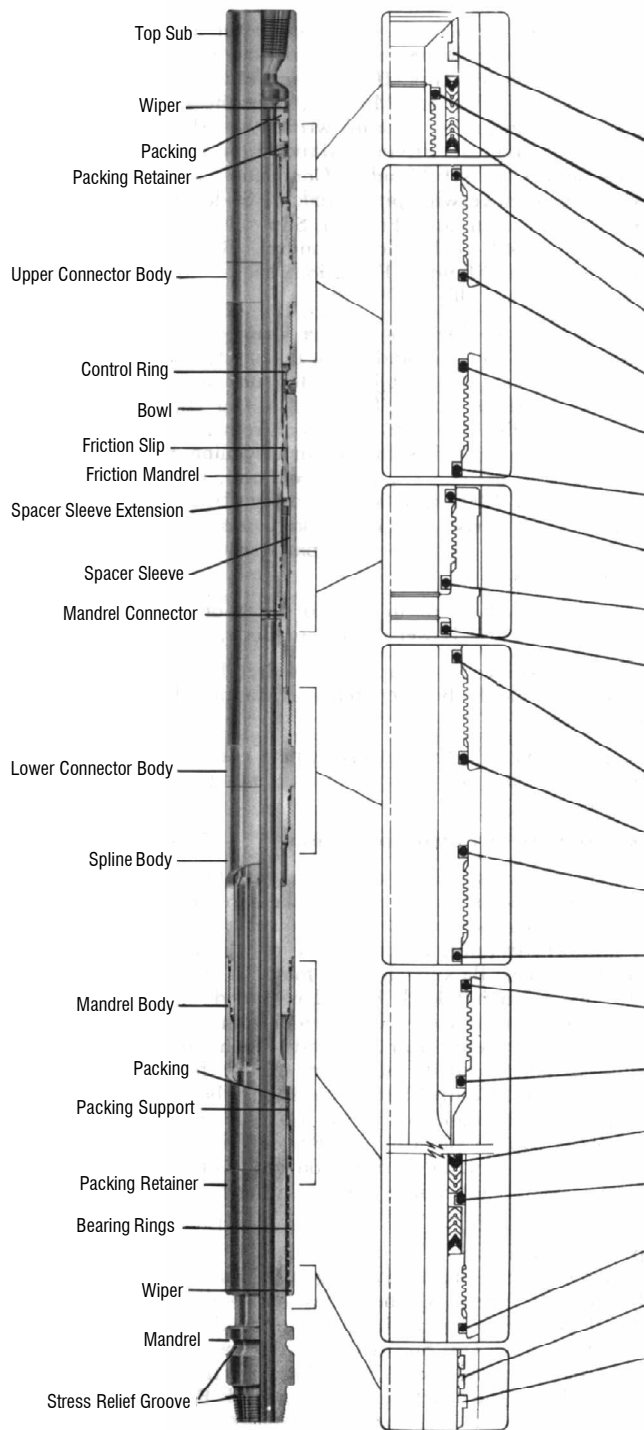


Figure 10
4-3/4" Down Jar
Seal, Packing, Wiper, and Ring Reassembly Guide



NOTE: Soft Rubber Packing Rings Shown in Black

ASSEMBLY NUMBER	72292	71552	79122	71925
Nominal O.D.	6"	6-1/4"	6-3/4"	7-3/4"
Part Name				
Wiper	72308	68450	79133	71712
O-Ring	30-10	30-14	30-14	30-18
Packing Set	72161	73751	79134	73752
O-Ring	30-24	30-27	30-29	30-35
O-Ring	30-27	30-30	30-32	30-37
O-Ring	30-27	30-30	30-32	30-37
O-Ring	30-24	30-27	30-29	30-35
O-Ring	30-14	30-16	30-16	30-20
O-Ring	30-11	30-14	30-14	30-17
O-Ring	30-12	30-15	30-15	30-19
O-Ring*				30-25
O-Ring	30-24	30-27	30-29	30-35
O-Ring	30-27	30-30	30-32	30-37
O-Ring	30-27	30-30	30-32	30-37
O-Ring	30-24	30-27	30-29	30-35
O-Ring	30-30	30-32	30-35	30-39
O-Ring	30-27	30-29	30-32	30-37
Packing Set (2)	72146	68878	78657	66094
O-Ring	30-27	30-29	30-32	30-38
O-Ring	30-30	30-32	30-35	30-40
Bearing Ring (11)	72149	71532	78659	71923
Wiper	72150	71531	78660	66102

CAUTION: Tool operation will be impaired if packing is improperly installed.

*7-3/4" size has extra O-Ring on Mandrel Connector.

Figure 11
6", 6-1/4" and 7-3/4" Down Jar
Seal, Packing, Wiper, and Ring Reassembly Guide

Pump with Bowen Jar Lube JL-519 and connect the hose to the Pressure Body Fill Plug port. Pump the Lube into the Jar until a bubble-free flow begins to come out of the air bleed hole. Remove Exhaust Hose. Replace the bleed hole plug and tighten it up. Remove the Lube Pump hose and replace the Fill Plug and tighten it up. The Up Jar is now ready for testing.

Testing the Up Jar

1. Make sure the Jar Tester subs are installed. Using crane, place Up Jar in Tester and set it for low pull load. See table on this page. Tool should take three to five minutes to release.
2. Set Jar Tester at standard test load allowable for the size of Tool and make four (4) pull tests. If the Tool does not pull up to standard test load, refer to table for lowest allowable test load. If it is below the lowest allowable test load, the Tool is malfunctioning and the problem must be determined and corrected before it is acceptable for field use.
3. If the load is above the lowest allowable test load, the Tool is ready for field use. Pull Up Jar open and remove it from the Tester. Remove Jar Tester subs and return them to storage. Tighten all body joints recommended torques if not already done. Install Dog Collars with the latch pin on the up end of the jar.

Disassembly of Down Jar Section

NOTE: For disassembly or reassembly, Down Jar should be in closed position so that Friction Slip is free. If not, put in Jar Tester and close before servicing.

1. Using crane, place Down Jar in Vise so that it clamps on Upper Connector Body. Using Tong, break out and remove Top Sub. If the Tool is a 6, 6-1/4, or 7-3/4 inch size, use Snap

Ring Pliers, Part No. 77216, to remove Friction Mandrel Packing Retainer Ring and let it hang on the O.D. of the Friction Mandrel. Using spanner wrench, loosen Friction Mandrel Packing Retainer. Remove Friction Mandrel Packing Adapter Wiper and, using pipe wrench on undercut area, break out and remove Friction Mandrel Packing Adapter. Then remove Retainer Ring. The Friction Mandrel Packing Retainer can now be unthreaded and the packing set removed.

NOTE: On the 4-3/4 inch size tool, the Friction Mandrel Packing Retainer is made up to the top of the Packing Adapter and both pieces may be removed from end of Friction Mandrel with pipe wrench on undercut areas provided.

2. Reposition in Vise to clamp on Bowl slightly below Control Ring port. Using Tong, breakout and remove Upper Connector Body.
3. Reposition to clamp on Lower Connector Body. Using Control Ring Plug Wrench, No. 86, remove Control Ring Plug. Using Tong, break out and remove Bowl. It is now possible to reach inside of the Bowl and thread out the Control Ring by hand (it has left-hand threads). If it binds, use penetrating oil and the handle of the Control Ring Plug Wrench or a large screwdriver as a lever, through the plug port, to coax it along.
4. Using pipe wrench on undercut on Friction Mandrel (a few inches above Friction Slip), remove Friction Mandrel. If the Mandrel Connector comes off with Friction Mandrel, slide the Spacer Sleeve off and, using back-up wrench on Mandrel Connector, remove Friction Mandrel from Mandrel Connector. (If Mandrel Connector stays on Mandrel, remove with pipe

wrench.) Slide Spacer Sleeve Extension and Friction Slip off Mandrel Connector end of Friction Mandrel. If Friction Slip hangs on Mandrel Extension, use a block of wood to drive it off.

5. Remove O-Rings from Lower Connector Body and pick up Top Sub and make up hand tight on Connector Body pin. Put Jar Tester subs on pin of Mandrel and in box of Top Sub. Using straight edge, scribe line along length of tool from Mandrel tool joint along Bodies to bottom of Spline Body (this will be used in reassembly of tool). Use Jar Tester, set a 4,000 to 6,000 lbs., to pull Mandrel out of Body parts, supporting Body sections and end of Mandrel as they come apart (see Figure 9 on page 18).
6. Place Body parts in Vise to clamp on Spline Body and remove Lower Connector Body.
7. Reposition to clamp on Mandrel Body and remove Spline Body, then remove Mandrel Packing Retainer.
8. Remove all O-Ring seals, wipers and packing from all parts. (See information on minor repairs on page 11.)

Reassembly of Down Jar Section

Prior to reassembly, the parts should all be thoroughly cleaned and dried. Make sure all parts are in good condition. Coat them with a thin oil, if not already done, and lay them on clean cloths or kraft paper. Be sure three or four lbs. of Bowen Itcolube is on hand. (It should be noted that no other lube is satisfactory for this tool in areas of severe friction and bearing loads such as the splines.) All threaded connections except the Control Ring and Control Ring Plug should be coated with Itcolube prior to making up. An adequate supply of cup grease, a

tube of Bowen Friction Slip Lube, Part No. 74285, and a good grade of thread locking compound should also be on hand.

The tool will normally require a complete set of packing each time it is redressed. The complete packing set consists of Packing, O-Rings, Bearing Rings, and Wipers. All these may be installed into the Packing Support and onto or into other parts (except for the Top Sub which will be used to assist in reassembly) prior to making up the main parts. Then the Packing Retainer and Retainer Ring where used should also be installed. See Figures 10 and 11 for a guide to installing Packing properly. If the Packing is installed backward, the operation of the Down Jar Section will be impaired.

1. Clamp Spline Body in Vise slightly above threads on end where splines are visible. This is the down end. Coat splines of Spline Body generously with Bowen Itcolube. (There is no way to add Itcolube after assembly.) Using crane, pick up Lower Connector Body and, using Tong, make it up to Spline Body. Using crane, pick up Mandrel Body and, using Tong, make it up to other end of Spline Body.
2. Reposition in Vise to clamp on Mandrel Body about ten inches above down end. Install Mandrel Body Packing Support with its Packing and O-Ring into the down end of the Mandrel Body. Spread some cup grease on the packing. Using Tong, make up Mandrel Packing Retainer to Mandrel Body.
3. Coat splines on Mandrel lightly with Bowen Itcolube. The lines scribed along the Body parts prior to disassembly (see Down Jar Disassembly Step 5) may or may not be realigned.

If they are not realigned, which is most likely, align a straight edge with the line scribed on the Spline Body so that a new line can be struck along the Mandrel Body and Mandrel Packing Retainer. Spread some cup grease on the Wiper and Bearing Rings of the Retainer.

4. Pick up Top Sub and make up hand tight onto pin thread of Lower Connector. Using crane, lift Mandrel and start inserting its up end through Wiper in Mandrel Packing Retainer, aligning scribed line on Mandrel with line scribed along Body parts, until splines begin to engage. Continue to carefully insert until splines disappear behind Wiper and polished diameter of Mandrel begins to enter.
5. Install Jar Tester subs on Mandrel Pin and in box of Top Sub. Place tool in Jar Tester and set Tester to push 4,000 to 6,000 lbs. Continue pushing until Mandrel is completely inserted (closed).
6. Remove tool subassembly from Jar Tester and place in Vise to clamp on Lower Connector Body. (Leave Jar Tester Subs installed until after testing.) Remove Top Sub, install its O-Rings, and set it aside. Using pipe wrench, make up Mandrel Connector to Mandrel. Slide Spacer Sleeve over Connector.
7. Coat Friction Slip and Friction Slip area of the Friction Mandrel heavily with Bowen Friction Slip Lube, Part No. 74285. Lift up Friction Mandrel and slide Friction Slip up to the area just before the place where it begins to grip the Mandrel. Slide the Spacer Sleeve Extension up next to the Slip (counter-bored end down). Using pipe wrench on wrenching area on Friction Mandrel (a few inches above Friction Slip), make up Friction Man-

drel to Mandrel Connector (this joint is inside Spacer Sleeve). If burrs are kicked up on wrenching area by pipe wrench during make up, file them down and wipe clean before installing next parts.

8. Open Mandrel until Mandrel Connector contacts Lower Connector Body. Coat Control Ring thread lightly with Bowen Friction Slip Lube and install it (small diameter pilot end first) into the up end (nearest the Control Ring Plug hole).

NOTE: This part has left hand threads. Do not run Control Ring in too far, only until the bottom of the slots appear about in the middle of the Control Ring Plug hole.

9. Using crane, lift up Bowl and as it is slid down over the Friction Mandrel, Slip, Spacer Sleeve Extension, and Spacer Sleeve, make sure the Spacer Sleeve Extension is not misaligned and that it enters the Bowl I.D. squarely. Then, using Tong, make the Bowl up to the Lower Connector Body.
10. Using crane, pick up Upper Connector Body, slide it down over Friction Mandrel, and, using Tong, make it up to Bowl. Reposition in Vise to Clamp on Upper Connector Body.
11. If the tool is a 6, 6-1/4, or 7-3/4 inch (see Figure 11) size, it has a Friction Mandrel Packing Adapter that has Packing which is installed from the down end and held with a Retainer and a Retainer Ring. This would normally be made up prior to main assembly along with the O-Ring and Packing Adapter Wiper. Using pipe wrench on undercut of Packing Adapter, make it up to Friction Mandrel. (If burrs are kicked up on undercut area by pipe wrench during make up, file them down and wipe clean before installing Top Sub.)

NOTE: On the 4-3/4 inch size tool (see Figure 10), the Packing is installed on the Friction Mandrel Packing Adapter from the up end and there is no Retainer Ring. If it has not been assembled prior to main assembly, install O-Ring in Adapter and, using pipe wrench on undercut, make it up to the Friction Mandrel. Install Packing on Adapter (see Figure 10) and install O-Ring and Wiper on Friction Mandrel Packing Retainer. Using pipe wrench, make up Retainer to Adapter. (If burrs are kicked up on undercuts by pipe wrench during make up, file them down and wipe them clean before installing Top Sub.)

12. Using crane, pick up Top Sub and, using Tong, make it up to Upper Connector Body. Remove the tool section from the Vise. It is now ready for testing.

Testing the Down Jar

1. Make sure the Jar Tester subs are installed. Using crane, place Down Jar in Tester and pull it open to full stroke length. Set Jar Tester at standard test load. See table below.
2. Using the handle of Control Ring Plug Wrench, No. 80733, or a large screwdriver as a lever, reach inside Control Ring Plug hole and turn Control Ring until Ring slots are in the

center of the Plug hole in the up-and-down direction. The Control Ring has left-hand threads. Actuate the Jar Tester and record the trip load. If the tool does not trip through at standard test load, rotate the Control Ring in the down-load (downhole) direction six (6) slots each time until it does trip.

If tool shows no-load, rotate the Control Ring in the up-load (up hole) direction six (6) slots on each test until a load build-up occurs. Adjust Control Ring and continue tests until standard test load is reached. Do not try to reach exact load; plus or minus two (2) tons is satisfactory.

3. Determine the load adjustment rate of increase by adjusting the Control Ring in the up direction ten (10) slots, test, and record this load. Then adjust the Control Ring down twenty (20) slots, test, and record this load.
4. Reset to field use load setting.
5. Determine stroke length by pulling the Jar open to its full stroke length. Adjust setting on Jar Tester to zero. Place measuring scale across the stroke length gap between the Mandrel shoulder and the Mandrel

Body Retainer. Gradually build up a load in the Tester and measure the remaining stroke length at the point where the tool actually trips. The distance should not be less than one (1) inch subtracted from the normal full stroke length of the tool. If it is less, the tool will not perform to its fullest capacity.

6. Using handle of the Control Ring Plug Wrench or a large screwdriver, move the Control Ring until the nearest slot is centered through the plug hole in the side-to-side direction. Move it only enough so that the down point on the Plug will enter the slot, which locks the Ring in place. Spread a good quality thread looking compound on threads of the Control Ring Plug, and using the Control Ring Wrench, install it lightly into the hole.
7. Pull Down Jar open and remove it from the Tester. Remove Jar Tester subs and return them to storage. Tighten all body joints to recommended torques if not already done. Install dog collar on the Mandrel making sure to insert the pin from the upward end so that it does not fall out when the tool is moved to a vertical position.

Mechanical Down Jars Strength Data

Assembly Part No.	Diameter (inches)		Threaded Connection	Lift Load (tons*)	Final Setting for Field Use (tons*)	Standard Load for Testing (tons*) Shop Only	Full Stroke Length (inches)
	Outside (Nominal)	Inside					
102073	9"	3-1/16"	7-5/8" Reg.	871	16	30	12
71925	7-3/4"	3-1/16"	6-5/8" Reg.	437	7-1/2	30	7
79122	6-3/4"	2-1/2"	5-1/2" Reg.	410	7-1/2	30	7
71983	6-1/4"	2-3/4"	4-1/2" I.F.	338	6	30	7
72292	6"	2-1/4"	4-1/2" F.H. 4-1/2" X-Hole	332	6	30	7-1/2
71916	4-3/4"	2"	3-1/2" I.F.	149	5	15	7

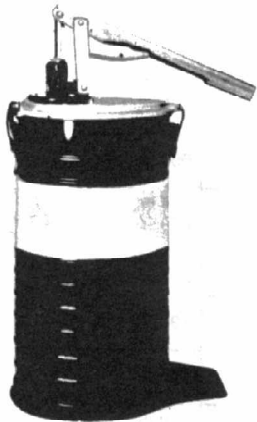
*2,000 lbs. per ton

** These field use setting loads are chosen to provide a good trip load over a wide range of hole conditions. There is a tendency, however, for the load required to trip to increase with depth and mud weight. It may be necessary in deeper holes to increase the trip load or lower the load at a faster rate.

It should also be noted that down jar trips are often difficult to observe on the rig floor.

Service Kit Part No. 77215

A Service Kit is necessary to properly service the Bowen Hydromechanical Drilling Jar. These kits are identical for every size tool.

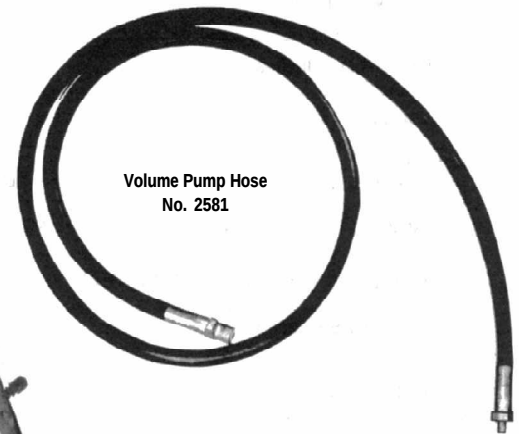


Jar Lube Pump
No. 2580

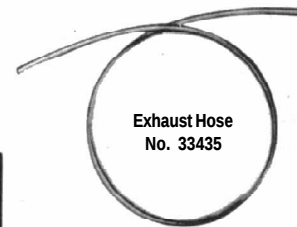
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Retainer Ring Pliers
No. 77216



Volume Pump Hose
No. 2581



Exhaust Hose
No. 33435



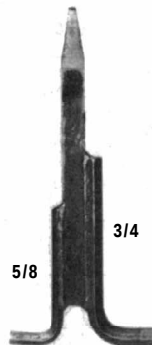
Spanner Wrench
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Control Ring
Installation Tool
No. 92195



Seal Protector Ring
Installation Tool
No. 625



Control Ring
Plug Wrench
No. 80733



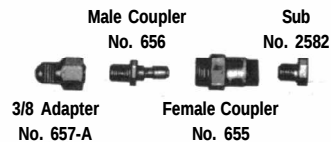
Fill Plug Wrench
No. 359



Fill Plug Wrench
No. 620



Volume Pump Repair Kit
No. 53266
(extra)



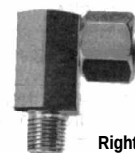
Line Filter
No. 56565



Bushing
No. 56563



Filter Element
No. 56566 (extra)



Reducing
Right Angle Adapter
No. 56564



Tube Fitting
No. 33436

Bowen Hydromechanical Drilling Jar

Size Connection	3-1/2 I.F.	4-1/2 Full Hole & X-Hole	4-1/2 I.F.	5-1/2 Reg.	6-5/8 Reg.
Minimum O.D. - Inches	4-3/4	6	6-1/4	6-3/4	7-3/4
I.D. - Inches	2	2-1/4	2-3/4	2-1/2	3-1/16
Length (Up Jar & Down Jar Assemblies Connected - Open)	33' - 5 ³ / ₄ "	37' - 5"	35' - 9 ¹ / ₂ "	36' - 3 ³ / ₄ "	37' - 7"
Torsional Yield In LB./FT. (Mandrel Splines)	33,000	64,000	75,000	90,000	122,000
Tensile Load Yield Capacity In Tons	270	320	375	620	650
Complete Assembly	Part No. 71902	73182	71556	79114	71614
Consisting of :	Weight 1619	2856	2513	3413	4765
Up Jar Assembly	Part No. 71903	72143	71528	78654	71920
	Weight 819	1494	1239	1708	2470
Length (Open)	17' - 8 ³ / ₄ "	19' - 7 ¹ / ₂ "	18' - 5"	18' - 6 ³ / ₄ "	19' - 6 ¹ / ₄ "
Total Stroke - Inches	12	13-1/2	13-1/2	13-1/2	14-1/2
Down Jar Assembly	Part No. 71916	72292	71552	79122	71925
	Weight. 800	1362	1274	1705	2295
Length (Open)	15' - 9 ¹ / ₂ "	17' - 9 ¹ / ₂ "	17' - 4 ¹ / ₂ "	17' - 9"	18' - 3 ¹ / ₄ "
Total Stroke - Inches	7	7 ¹ / ₂	7	7	7

Replacement Parts - Up Jar Assembly

Up Jar Assembly	Part No. 71903	72143	71528	78654	71920
	Weight 610	1350	1425	1745	2225
Spline Body	Part No. 69192	72144	69892	78655	69257
	Weight 100	195	218	255	335
Spline Body Seal (Large)	Part No. 30-21	30-30	30-32	30-35	30-39
	Weight 1/8	3/16	3/16	3/16	1/4
Spline Body Seal (Small)	Part No. 30-19	30-27	30-29	30-32	30-37
	Weight 1/8	3/16	3/16	3/16	1/4
Mandrel Body	Part No. 69190	72145	68183	78656	69255
	Weight 49	100	90	105	159
Mandrel Body Packing Set (2 Req'd.)	Part No. 69146	72146	68878	78657	66094
	Weight 1/8	1/4	1/4	1/4	3/8
Mandrel Body Packing Support	Part No. 69147	72147	68877	78744	66095
	Weight 1	1-1/2	1-1/2	1-1/2	2-1/2
Mandrel Body Packing Support Seal	Part No. 30-19	30-27	30-29	30-32	30-38
	Weight 1/8	3/16	3/16	3/16	1/4
Mandrel Packing Retainer	Part No. 71904	72148	71530	78658	71922
	Weight 31	52	55	70	87
Mandrel Packing Retainer Bearing Ring (11 Req'd.)	Part No. 71905	72149	71532	78659	71923
	Weight 1/5	1/4	1/4	1/4	1/3
Mandrel Packing Retainer Wiper	Part No. 69154	72150	71531	78660	66102
	Weight 1/5	1/2	3/8	3/8	3/8
Mandrel Packing Retainer Seal	Part No. 30-21	30-30	30-32	30-35	30-40
	Weight 1/8	3/16	3/16	3/16	1/4
Mandrel	Part No. 71906	72151	71529	78661	71921
	Weight 160	319	328	483	585
Mandrel Seal	Part No. 30-9	30-13	30-16	30-16	30-23
	Weight 1/8	3/16	3/16	3/16	1/4

Bowen Hydromechanical Drilling Jar

Up Jar Assembly	Part No.	71903	72143	71528	78654	71920
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Replacement Parts - Up Jar Assembly (Continued)

Mandrel Extension	Part No.	69193	72152	68186	78662	69258
	Weight	87	141	130	155	221
Mandrel Extension	Part No.	69195	72153	68188	78663	69260
Packing Set (Upper)	Weight	1/5	1/5	1/5	1/5	1/4
Mandrel Extension	Part No.	69197	72154	68190	78664	69262
Middle Packing Ring	Weight	3/4	1-1/3	1	1	1
Mandrel Extension	Part No.	69196	72155	68189	78665	69261
Packing Set (Lower)	Weight	1/4	1/4	3/8	3/8	3/8
Mandrel Extension	Part No.	69198	72157	68191	78666	69263
Packing Retainer	Weight	1-3/4	2-1/2	2-3/4	2-3/4	2-3/4
Mandrel Extension Packing	Part No.	69200	72156	70597	78667	69265
Retainer Wiper Seal	Weight	1/8	1/4	3/16	3/16	3/16
Mandrel Extension Packing	Part No.	69199	72158	68192	68192	69264
Retainer Ring	Weight	3/16	3/16	3/16	1/4	1/4
Connector Body	Part No.	69194	72159	69894	78668	69259
	Weight	46	84	70	95	185
Connector Body Wiper	Part No.	70536	72160	69895	69895	70193
	Weight	1/4	1/4	3/8	3/8	3/8
Connector Body Seal (Small - Lower)	Part No.	30-17	30-23	—	—	—
	Weight	1/8	3/16	—	—	—
Connector Body Seal (Small - Upper)	Part No.	30-17	30-24	30-27	30-29	30-35
	Weight	1/8	3/16	3/16	1/4	1/4
Connector Body Seal (Large) (2 Req'd.)	Part No.	30-20	30-27	30-30	30-32	30-37
	Weight	1/8	3/16	3/16	1/4	1/4
Connector Body Packing Set (Upper)	Part No.	69204	72161	68197	68197	69270
	Weight	1/4	1/4	1-1/4	1-1/4	1-1/2
Connector Body Packing Set (Center) (2 Req'd.)	Part No.	—	—	68198	68198	69270
	Weight	—	—	1-3/4	1-3/4	1-3/4
Connector Body Packing Set (Lower)	Part No.	—	—	68199	78669	69271
	Weight	—	—	1/3	1/3	3/8
Connector Body Packing Retainer	Part No.	—	—	68200	78670	69272
	Weight	—	—	2-1/4	2-1/4	2-1/4
Connector Body Adapter	Part No.	70632	72166	—	—	—
	Weight	44	36	—	—	—
Connector Body Adapter Packing Support	Part No.	71667	72164	—	—	—
	Weight	2	2-1/4	—	—	—
Connector Body Adapter Packing Support Seal	Part No.	71678	72165	—	—	—
	Weight	1/16	1/16	—	—	—
Connector Body Adapter Packing Set (Upper-thin)	Part No.	69205	72162	—	—	—
	Weight	1/16	1/2	—	—	—
Connector Body Adapter Packing Set (Upper - Thick)	Part No.	71664	72163	—	—	—
	Weight	1/2	3/4	—	—	—
Connector Body Adapter Seal	Part No.	30-20	30-27	—	—	—
	Weight	1/8	1/8	—	—	—
Connector Body Adapter Packing Set (Lower)	Part No.	69206	72167	—	—	—
	Weight	1/4	1/4	—	—	—
Fill Plug	Part No.	329	329	329	329	329
	Weight	1/16	1/16	1/16	1/16	1/16
Fill Plug Seal	Part No.	27-1	27-1	27-1	27-1	27-1
	Weight	1/16	1/16	1/16	1/16	1/16
Piston Assembly (Cone Type)	Part No.	69209	72169	68202	78671	69274
	Weight	8	9	12	15	20
Cone	Part No.	69210	72170	68203	78672	69275
	Weight	5	6	8-1/2	10-1/2	15-1/2

Bowen Hydromechanical Drilling Jar

Up Jar Assembly	71903	72143	71528	78654	71920
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Replacement Parts - Up Jar Assembly (Continued)

By-pass Body	Part No.	69212	72171	68361	68361	69277
	Weight	1/2	3/4	3/4	3/4	1
Seal Body	Part No.	69211	72172	68204	78673	69276
	Weight	1-1/2	2	2-1/2	3	3-1/4
Seal Body Seal	Part No.	73955	73961	73957	73957	73963
	Weight	1/16	1/16	1/16	1/16	1/16
Washpipe	Part No.	80217	80414	80279	81706	81550
	Weight	35	64	69	75	114
Washpipe Seal (Small)	Part No.	30-9	30-12	30-15	—	—
	Weight	1/8	3/16	3/16	—	—
Mandrel Extension Seal	Part No.	—	—	—	30-13	30-18
	Weight	—	—	—	3/16	1/4
Washpipe Seal (Large)	Part No.	30-10	30-15	30-18	30-18	30-24
	Weight	1/8	3/16	3/16	3/16	1/4
Floater	Part No.	69214	72174	68206	78675	69279
	Weight	1-1/2	1	1-1/4	1-1/4	1-3/4
Floater Seal O.D. (4 Req'd.)	Part No.	27-44	27-50	73777	568-353	73781
	Weight	1/8	1/8	1/8	1/8	1/8
Floater Seal I.D. (4 Req'd.)	Part No.	73780	73779	73778	73778	73782
	Weight	1/8	1/8	1/8	1/8	1/8
Pressure Body	Part No.	69208	72177	69896	78677	69273
	Weight	75	177	120	197	306
Fill Plug	Part No.	617	329	329	329	329
	Weight	1/16	1/4	1/4	1/4	1/4
Fill Plug Seal	Part No.	27-3/4	27-1	27-1	27-1	27-1
	Weight	1/16	1/16	1/16	1/16	1/16
Washpipe Body	Part No.	69218	72178	69898	78678	69283
	Weight	86	140	140	244	292
Washpipe Body Seal (Large)	Part No.	30-20	30-27	30-30	30-32	30-37
	Weight	1/8	3/16	3/16	3/16	3/16
Washpipe Body Seal (Small)	Part No.	30-17	30-23	30-27	30-29	30-35
	Weight	1/8	3/16	3/16	3/16	3/16
Washpipe Body Wiper Ring	Part No.	74596	72179	74597	—	74598
	Weight	1/8	3/16	3/16	—	1/4

Required Accessories

Packing Assembly Sleeve (For Mandrel Extension) (Req'd. For Assembly of Tool)	Part No.	70627	72180	69421	69421	70635
	Weight	1/4	1/4	1/4	1/4	1/4
Thread Protector For Pin Connection	Part No.	63079	63079	63082	63084	63087
	Weight	1/2	1/2	3/4	3/4	1
Thread Protector For Box Connection	Part No.	63096	63102	63101	63103	63106
	Weight	1/2	1/2	3/4	3/4	1
Dog Collar	Part No.	77230	77231	77232	79286	77233
	Weight	13	13-1/2	13-1/2	13-1/2	14

Optional - Extra

O-Ring Packing Set	Part No.	70636	72182	69901	78679	70199
	Weight	2	3	3	3	4
Complete Packing Set	Part No.	71907	72183	71533	78680	71924
	Weight	5	5	6	6	7
Lifting Sub Elevator Type	Part No.	—	—	72539	59592	—
	Weight	30	38	45	56	65

Bowen Hydromechanical Drilling Jar - Replacement Parts - Down Jar Assembly

Down Jar Assembly	Part No.	71916	72292	71552	79122	71925
	Weight	590	1225	1375	1525	2090
Spline Body	Part No.	69224	72293	70002	79123	69289
	Weight	72	122	129	146	183
Spline Body Seal (Large)	Part No.	30-21	30-30	30-32	30-35	30-39
	Weight	1/8	3/16	3/16	3/16	1/4
Spline Body Seal (Small)	Part No.	30-19	30-26	30-29	30-32	30-37
	Weight	1/8	3/16	3/16	3/16	1/4
Mandrel Body	Part No.	69225	72294	68443	79124	69290
	Weight	29	75	79	85	110
Mandrel Body Packing Set (2 Req'd.)	Part No.	69146	72146	68878	78657	66094
	Weight	1/8	1/4	1-1/2	1-1/2	1-3/4
Mandrel Body Packing Support	Part No.	69147	72147	68877	78744	66095
	Weight	1	1-1/4	1-1/2	1-1/2	2-1/2
Mandrel Body Packing Support Seal	Part No.	30-19	30-27	30-29	30-32	30-38
	Weight	1/8	3/16	3/16	3/16	1/4
Mandrel Packing Retainer	Part No.	71917	72297	71553	79125	71926
	Weight	19	52	52	75	85
Mandrel Packing Retainer Bearing Ring (11 Req'd.)	Part No.	71905	72149	71532	78659	71923
	Weight	1/4	1/4	1/4	1/4	1/4
Mandrel Packing Retainer Wiper	Part No.	69154	72150	71531	78660	66102
	Weight	1/4	1/4	3/8	3/8	1/2
Mandrel Packing Retainer Seal	Part No.	30-21	30-30	30-32	30-35	30-40
	Weight	1/8	3/16	3/16	3/16	1/4
Mandrel	Part No.	71918	72300	71554	79126	71927
	Weight	210	365	363	500	595
Mandrel Seal	Part No.	30-7	30-12	30-15	30-15	30-19
	Weight	1/8	1/8	1/8	1/8	1/8
Connector Body (2 Req'd.)	Part No.	69223	72301	70001	79127	69288
	Weight	43	88	93	105	150
Connector Body Seal (Large) (4 Req'd.)	Part No.	30-20	30-27	30-30	30-32	30-37
	Weight	1/8	1/8	1/4	1/4	1/4
Connector Body Seal (Small) (4 Req'd.)	Part No.	30-17	30-24	30-27	30-29	30-35
	Weight	1/8	1/4	1/4	1/4	1/4
Mandrel Connector	Part No.	69229	72302	70004	79128	69294
	Weight	14	33	33	40	62
Mandrel Connector Lower Seal	Part No.	—	—	—	—	30-25
	Weight	—	—	—	—	1/4
Spacer Sleeve	Part No.	69237	72303	68456	79129	69302
	Weight	11	18	17	22	28
Spacer Sleeve Extension	Part No.	70641	72304	70553	79130	71692
	Weight	2	1-3/4	1-3/4	2	3
Friction Mandrel	Part No.	69230	72305	70005	79131	69295
	Weight	38	82	62	89	65
Friction Slip	Part No.	7382	72306	7134	7134	7283
	Weight	9	10	14	14	21
Friction Mandrel Lower Seal (Small)	Part No.	30-6	30-11	30-14	30-14	30-17
	Weight	1/16	1/8	1/8	1/8	1/8
Friction Mandrel Lower Seal (Large)	Part No.	30-8	30-14	30-16	30-16	30-20
	Weight	1/8	1/8	1/8	1/8	1/8
Friction Mandrel Packing Adapter	Part No.	69231	72307	70006	79132	69296
	Weight	7	10	20	24	34
Friction Mandrel Packing Adapter Seal	Part No.	30-7	30-10	30-14	30-14	30-18
	Weight	1/8	1/8	1/8	1/8	1/8
Friction Mandrel Packing Adapter Packing Set	Part No.	73750	72309	73751	79134	73752
	Weight	1/4	1/4	1/4	1/4	1/4

Bowen Hydromechanical Drilling Jar

Down Jar Assembly	Part No.	71916	72292	71552	79122	71925
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Replacement Parts - Down Jar Assembly (Continued)

Friction Mandrel Packing	Part No.	—	72310	68452	79141	69299
Adapter Packing Retainer	Weight	—	2-1/2	2	2	2
Friction Mandrel Packing	Part No.	—	72311	68192	79373	69264
Adapter Packing Retainer Ring	Weight	—	1/8	1/8	1/8	1/8
Friction Mandrel Packing	Part No.	—	72308	68450	79133	71712
Adapter Wiper	Weight	—	1/3	3/8	3/8	1/3
Friction Mandrel Packing Retainer	Part No.	69234	—	—	—	—
	Weight	4	—	—	—	—
Friction Mandrel Packing Retainer Seal	Part No.	30-7	—	—	—	—
	Weight	1/8	—	—	—	—
Friction Mandrel Packing Retainer Wiper	Part No.	69232	—	—	—	—
	Weight	1/4	—	—	—	—
Bowl	Part No.	81006	81007	81013	81014	81015
	Weight	91	175	160	212	273
Control Ring	Part No.	69235	72313	68454	81008	69300
	Weight	2	3	3	3	3-1/4
Control Ring Plug	Part No.	81002	81003	81003	81004	81005
	Weight	1/4	1/3	1/3	1/3	2/3
Control Ring Plug Seal	Part No.	80999	80999	80999	80999	80998
	Weight	—	—	—	—	—
Top Sub	Part No.	69220	72315	71982	79137	69385
	Weight	80	157	150	223	267

Required Accessories

Thread Protector	Part No.	63079	63083	63082	63084	63087
For Pin Connection	Weight	1/2	1/2	3/4	3/4	1
Thread Protector	Part No.	63096	63702	63101	63103	63106
For Box Connection	Weight	1/2	1/2	3/4	3/4	1
Dog Collar	Part No.	77234	77235	77236	79291	77237
	Weight	2	2-1/2	2-1/2	2-1/2	3
Itcolube - 50 Lb. Container	Part No.	64919	64919	64919	64919	64919
	Weight	60	60	60	60	60
Control Ring	Part No.	77628	77628	77628	77628	77628
Plug Adhesive	Weight	1/4	1/4	1/4	1/4	1/4
Service Kit	Part No.	77215	Only One Service Kit required for all sizes of Hydromechanical Drilling Jars - Does not include Up Jar Packing Assembly sleeve which must be ordered separately as required for each tool.			
	Weight	72				

Optional - Extra

O-ring Packing Set	Part No.	71626	72445	68640	79138	70167
	Weight	1-1/2	2	2	2	3
Complete Packing Set	Part No.	71919	72446	71555	79139	71928
	Weight	4	5	5	6	6
Lifting Sub Elevator Type	Part No.	77559	—	72539	—	77558
	Weight	30	—	45	—	50
Friction Slip Lube (1 Tube)	Part No.	74285	74285	74285	74285	74285
	Weight	1	1	1	1	1
Friction Slip Lube (1can)	Part No.	79684	79684	79684	79684	79684
	Weight	7	7	7	7	7

How to order Specify:

- (1) Name and Number of Assembly or Part.
- (2) Size and Type of Connections, if Other than Standard.
- (3) Outside Diameter.
- (4) Any Spares or Extras desired, by Name and Number.

Recommended spare parts : Up Jar

- (1) 1 Packing Assembly Sleeve
- (2) 8 Complete Packing Sets
- (3) 16 Fill Plugs
- NOTE : 4³/₄ Tool - 8 P/N 329 & 8 P/N 617 - 6¹/₄ & 7³/₄ Tools - 16 P/N 329
- (4) 1 Cone
- (5) 1 Seal Body
- (6) 1 Floater

Down Jar

- (1) 2 O-Ring Packing Sets
- (2) 8 Complete Packing Sets
- (3) 1 Control Ring Plug
- (4) 1 Friction Slip
- (5) 1 Friction Mandrel
- (6) 1 Tube - Friction Slip Lube

Miscellaneous O-Ring Seals are normally furnished in sealed plastic bags of 10, 25, or 100 pieces each to prevent deterioration. Other quantities will be furnished in unsealed packages. Packing Sets, however, will always be furnished in sealed plastic bags.

Disassembly of Up Jar Section for 9" Drilling Jar

NOTE: For disassembly or reassembly, the Up Jar should be in the open position, Mandrel exposed, so that Cone is in the free area. Put the Jar in the Jar Tester. Fully open the Jar, then close it 3".

1. Using crane, place Up Jar in Vise with Mandrel extended as explained above and clamp about 15 inches above lower end of Pressure Body, or just below fill plug in middle of Pressure Body. Coat Washpipe Body pin threads with Bowen Itcolube (anti-gall compound) and make-up thread protector to pin. Then use Tong to remove Washpipe Body.
2. Reposition in Vise to clamp on Connector Body. Place pan to catch hydraulic oil under Pressure Body joint. Using Tong, break out Pressure Body and let oil drain, then slide it off over the Washpipe. The Floater will tend to follow the Pressure Body, so when it is off, it is usually possible to reach inside and pull the Floater out the bottom. If the Floater has slid up, a long board may be used to push it out the bottom from the opposite end. The Floater seals may be removed using Bowen Part No. 625 or a screwdriver with the tip bent at about an 80 degree angle.
3. Place pipe wrench on undercut wrench area at upper end of Washpipe, and begin to break connection. If Mandrel Extension begins unthreading from Mandrel, cease wrenching until Mandrel Extension can be held back by other pipe wrench on undercut wrench area at it bottom end. Then remove Washpipe, Seal Body, Cone, and By-Pass Body. Handle the Seal Body, Cone and By-Pass Body carefully and wrap them in cloth when removed.
4. Reposition tool in Vise to clamp a few inches above vent holes in spline body. Using a pipe wrench on undercut wrench area of Mandrel Extension, break loose the Mandrel Extension but do not remove it.
5. Using a Tong, remove Connector Body from Spline Body. Middle Packing Sets, Wipers, and Seals may be removed with No. 625 or bent screwdriver.
6. Using pipe wrench on undercut wrench area of Mandrel Extension, remove Mandrel Extension. (The Mandrel Extension joint is inside lower end of Spline Body.) After removal, use Snap Ring Pliers, Part No. 77216, to remove Packing Retainer Ring. Pick up Washpipe Body, remove both O-Ring Seals and make up hand tight into lower box thread of Spline Body.
7. Put Jar Tester subs in Mandrel Box and on pin of Washpipe Body, remove tool from Vise and place tool in Jar Tester. Using straight edge, scribe line along length of tool from end of Mandrel Box connection across Mandrel, Packing Retainer, Mandrel Body and to bottom end of Spline Body (this is to assist in aligning the splines during reassembly of tool). Set Tester at low pull, 4,000 to 8,000 lbs., and pull Mandrel out of the assembly in on section. Be careful to support ends of Mandrel and Body parts as they are pulled apart (see Figure 6 on page 13).
8. Reposition Body parts in Vise to clamp on Mandrel Body and, using Tong, remove the Mandrel Packing Retainer.

NOTE: This joint has left-hand threads.

9. Reposition in Vise if necessary to clamp on upper end of Spline Body and, using Tong, remove Mandrel Body.

NOTE: The joint has left hand threads.

10. Remove all O-Rings, Wipers, and Packing from all parts and thoroughly clean them. Look carefully for any galled areas or worn portions which may need to be replaced. Remove Fill Plugs from tool.

On parts of both Up Jar and Down Jar the following inspection and minor repairs may be made:

1. Carefully clean all the disassembled parts with solvent and wipe them dry with a lint free, clean cloth.
2. Check all the parts for defects. Examine all polished surfaces for pits and scratches. Any abrasions on these surfaces will damage the Packing and O-Ring seals, resulting in loss of fluid or pressure during the operation of the tool. Any rough, shallow pits, or burrs, may be removed by use of fine emery cloth. Parts with major pits or deep scratches and grooves must be replaced.
3. Check the splines on the Mandrels and in the Spline Bodies for burrs or upsets. These may be carefully ground away with a grinder or a small hand file and afterwards polished with emery cloth.
4. Examine the bores of the Connector Bodies and Mandrel Bodies for signs of scratches or galls. Minor damage of this nature may be smoothed out with emery cloth, or if very minor, may be disregarded. Any deep scratches in the smooth bore of these parts will render them unfit for further service.

5. Up Jar. Carefully examine the Cone. Polish off any abrasions, nicks, galls or burrs at the O.D., I.D., or face. Carefully use a small hand file or emery cloth because these surfaces are ground.

Any damage to the Cone, By-Pass Body or Seal Body surfaces will render them unusable.

6. Down Jar. Examine the Friction Slip, Bowl Liner, Friction Mandrel, and Bowl I.D. for signs of peripheral cracks and damage. They must be replaced if such defects appear.
7. Carefully check the tool joint threads for nicks, or burrs, removing any found. Then thoroughly oil all the parts with a good grade of light, clean oil.

Reassembly of Up Jar Section

NOTE: Do not fully torque body joints of jar until filled jar has been tested!

Prior to reassembly, the parts should all be thoroughly cleaned and dried. Make sure all parts are in good condition. Coat them with a thin oil, if not already done, and lay them out on clean cloths or kraft paper. Be sure three or four lbs. of Bowen Itcolube are on hand. It should be noted that no other lube is satisfactory for this tool in areas of severe friction and bearing loads such as the splines. All threaded connections should be coated with Itcolube prior to making up. An adequate supply of cup grease and a small amount of Bowen Jar Lubricant should also be on hand.

The tool will normally require a complete set of packing each time it is redressed. The complete packing set consists of Packing, O-Rings, Bearing Rings, Wipers and Polypak Seals. All these may be installed onto or into Packing Supports and other parts (except for the Washpipe Body which will be used to assist in reassembly) prior to making up the main parts. Then Packing Retainers and Retainer Rings should also be installed. See Figure 13 on page 33 for a guide to installing Packing and Polypak Seals properly. If they are installed backward, the tool will not operate.

1. Clamp Spline Body in Vise immediately below up and threads. The end with splines is the up end and the end near the vent holes is the down end. Coat splines of Spline Body generously with Bowen Itcolube. (There is no way to add Itcolube after assembly.) Using Tong, make up Mandrel Body to Spline Body.

NOTE: This joint has left-hand threads.

2. Install Mandrel Body Packing Set into the up end of the Mandrel Body. Spread some cup grease on the Packing. Using Tong, make up Mandrel Packing Retainer to Mandrel Body.

NOTE: This joint has left-hand threads.

3. Coat splines on Mandrel lightly with Bowen Itcolube. The lines scribed along the Body parts prior to disassembly (see Up Jar disassembly Step 7) may or may not now be realigned. If they are not realigned, which is most likely, align a straight edge with the scribed line on the Spline Body so that a new line can be struck along the Mandrel Body and Mandrel Packing Retainer. Spread some cup grease on the Wiper and Bearing Rings of the Retainer.

4. Pick up Washpipe Body and make up hand tight into lower box thread of Spline Body. Using crane, lift Mandrel and start inserting its down end through Wiper in Mandrel Packing Retainer, aligning scribed line on Mandrel with line scribed along Body parts, until splines begin to engage. Continue to carefully insert until splines disappear behind Wiper and polished diameter of Mandrel begins to enter.

5. Install Jar Tester subs in Mandrel box and on pin of Washpipe Body. Place tool in Jar Tester and set Tester to push 4,000 to 8,000 lbs. Continue pushing until Mandrel is completely inserted.
6. Remove tool subassembly from Jar Tester and place in Vise to clamp on Spline Body a few inches above vent holes. (Leave Jar Tester Subs installed until after filling and testing.) Remove Washpipe Body, and set it aside. Place Mandrel Extension up end, with its Packing, Retainer, Seal and Retainer Ring installed, inside of the Spline Body. Using pipe wrench on undercut wrench area of Mandrel Extension, make up connection. (If burrs are kicked up on undercut area by pipe wrench during make up, file them down and wipe clean before installing next parts.) Coat the Assembly Sleeve with cup grease and slide it up over end of Mandrel Extension until it is against the By-Pass Body Shoulder on the Extension.
7. Slide Connector Body up Mandrel Extension and make it up to Spline Body. Remove Packing Assembly Sleeve and return it to storage.

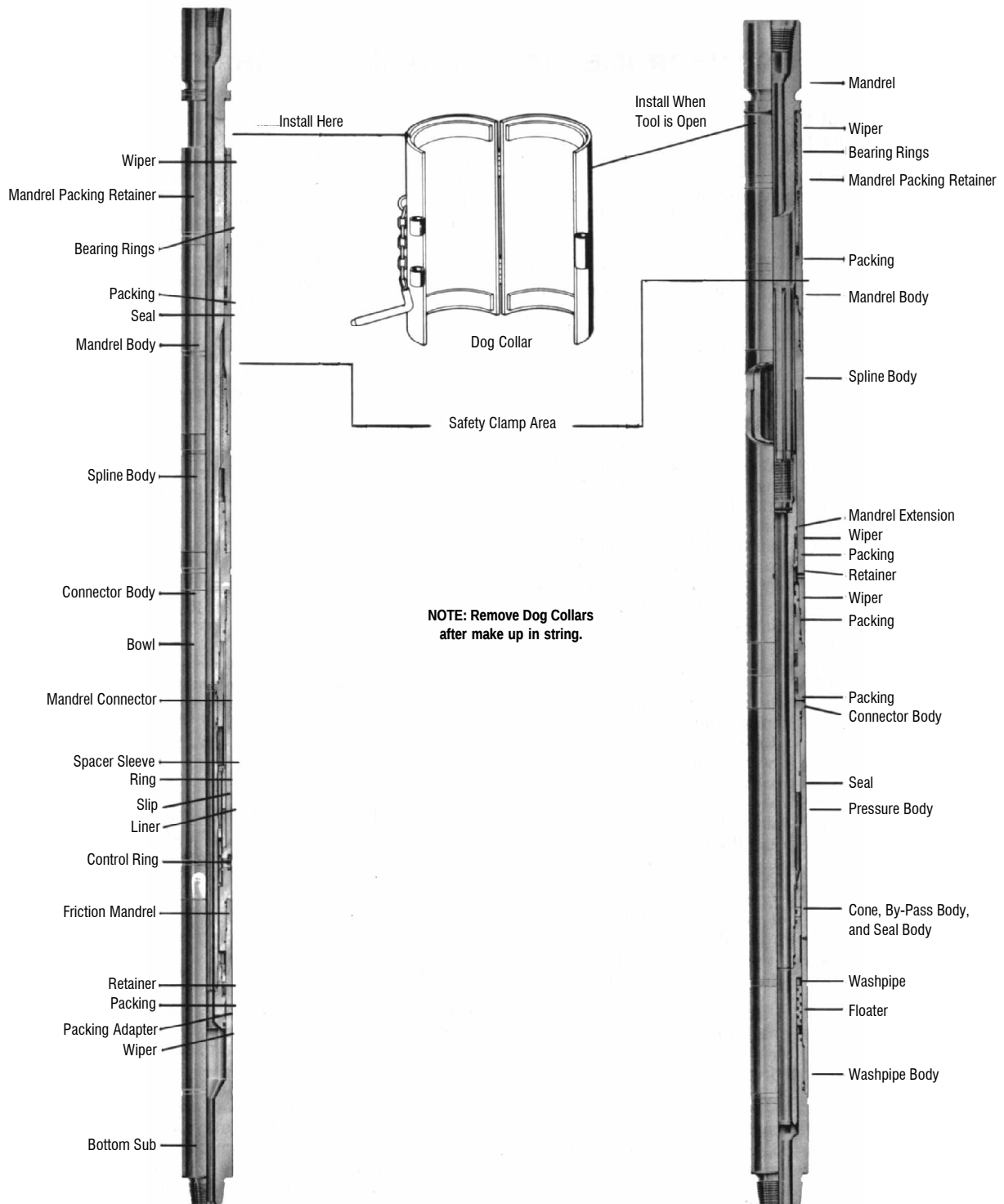


Figure 12
Dog Collar and Safety Clamp Areas for 9" Drilling Collar

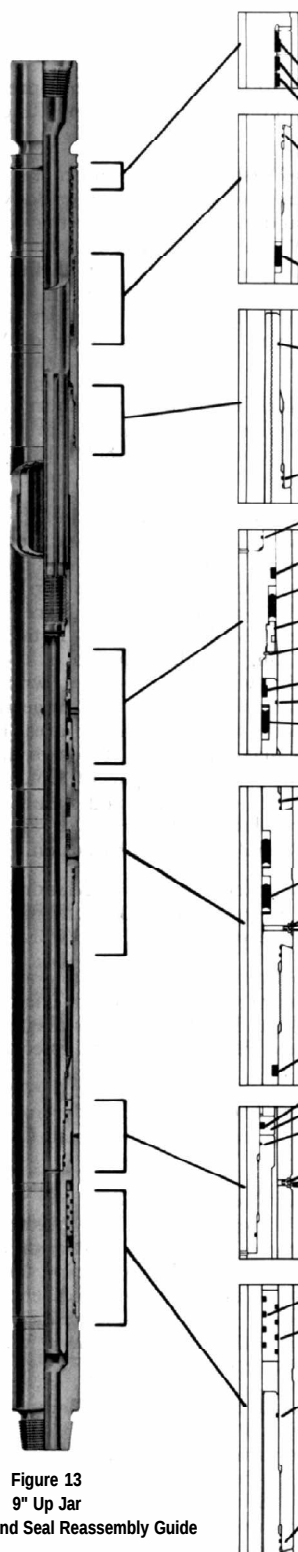


Figure 13
9" Up Jar
Wiper, Ring, and Seal Reassembly Guide

NOTE: Soft Rubber Packing Rings Shown in Black

ASSEMBLY NUMBER		102072
Part Name	Nominal O.D.	9"
Mandrel Packing Retainer Wiper		102080
Mandrel Packing Retainer Wear Ring (11 req.)		102079
Mandrel Packing Retainer Seal		30-43
Mandrel Body Packing Set		102077
Spline Body Seal (Small)		30-41
Spline Body Seal (Large)		30-43
Mandrel Seal		30-27
Mandrel Extension Wiper Seal		102084
Mandrel Extension Packing Set		102083
Mandrel Extension Packing Retainer		102085
Mandrel Extension Packing Retainer Ring		102086
Connector Body Wiper		102088
Connector Body Seal		30-39
Connector Body Packing Set (Upper)		102091
Connector Body Seal (Large) (2 req.)		30-41
Connector Body Packing Set (Center) (2 req.)		102090
Fill Plug Seal		568-010
Fill Plug Back-Up Ring		8-010
Fill Plug		102025
Connector Body Seal		102089
Seal Body Seal		102095
Seal Body		102094
Washpipe Seal		30-26
Fill Plug Seal		568-010
Fill Plug		102025
Fill Plug Back-Up Ring		8-010
Floater Seal I.D. (4 req.)		102098
Floater Seal O.D. (4 req.)		568-363
Washpipe Body Seal (Small)		30-39
Washpipe Body Seal (Large)		30-41
Mandrel Extension Seal (Not Shown)		30-21

CAUTION: Tool will not operate if Packing and Seals are improperly installed.

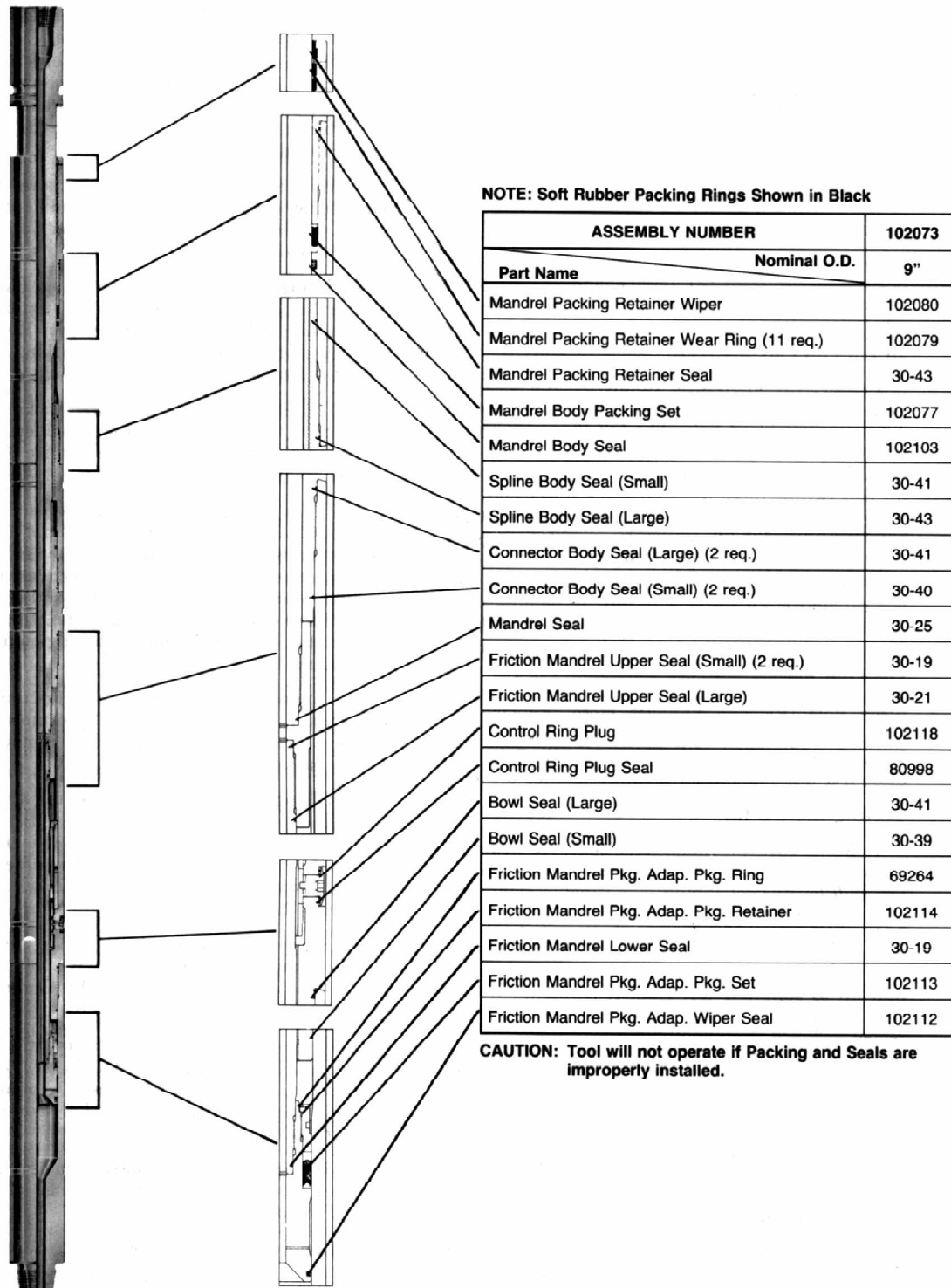


Figure 14
9" Down Jar
Wiper, Ring, and Seal Reassembly Guide

8. Pick up Pressure Body and temporarily install it onto end of Connector Body. Then pick up Washpipe Body and temporarily install it into end of Pressure Body. Place tool in Jar Tester and fully open the jar.
9. Clamp assembly in vise and remove Pressure Body and Washpipe Body. Install O-Rings on Washpipe Body.
10. Install By-Pass Body, Cone and Seal Body onto Mandrel Extension. Pick up Washpipe and using pipe wrench, make it up to Mandrel Extension. Clean Cone assembly, Washpipe and Mandrel Extension of all fillings, grease, etc., which could contaminate the oil. Using crane, pick up Pressure Body and slide it up over Washpipe. Make it up to Connector Body.
11. Place stand under Pressure Body a few inches below Fill Plug hole. Coat Floater with Bowen Jar Lubricant JL-519 and squirt some up inside the cavity between the Washpipe and the Pressure Body. Slide Floater up over Washpipe until it passes two or three inches of threads in the lower box connection of the Pressure Body.
12. Using crane, pick up Washpipe Body and make it up to Pressure Body. As this joint is made up, the Floater is pushed into the proper position for standard service.

NOTE: The Mandrel should not be opened or closed until it is filled with Jar Lube. Remove the tool section from the Vise. It is now ready for filling.

NOTE: Do not fully torque body joints of jar until filled jar has been tested!

Filling the Up Jar

In the Up Jar, the Floater is automatically positioned for standard service and the Mandrel should not be opened or closed until the process of filling the Section with Jar Lube is completed and all Fill Plugs are inserted.

Remove the Fill Plugs. Rotate Section until the plug hole on Connector Body is pointing upward. This is an air bleed hole. The Fill Plug port on the lower end of the Pressure Body may be in any position. Tilt tool at least 10 degrees with the box or up end two or three feet above the lower end. Resting the up end in an open Vise is suitable. Connect one end of the Exhaust Hose (with fittings) to the air bleed hole and place the other end into the hole in the top of the Jar Lube Pump (this hose is clear plastic for the flow of lube to be observed.) Load the Jar Lube Pump with Bowen Jar Lube JL-519 and connect the hose to the Pressure Body Fill Plug port. Pump the Lube into the Jar until a bubble-free flow begins to come out of the air bleed hole. Remove Exhaust Hose. Replace the bleed hole plug and tighten it up. Remove the Lube Pump hose and replace the Fill Plug and tighten it up. The Up jar is now ready for testing.

Testing the Up Jar

1. Make sure the Jar Tester subs are installed. Using crane, place Up Jar in Tester and set it for low pull load. Tool should take three to eight minutes to release.
2. Set Jar Tester at standard test load allowable and make four (4) pull tests. If the Tool does not pull up to standard test load, it is malfunctioning and the problem must be determined and corrected before it is acceptable for field use.

3. Pull Up Jar open and remove it from the Tester. Remove the jar tester subs and return them to storage. Tighten all body joints to recommended torques if not already done. Install Dog Collars with the latch pin toward the up end of the jar.

Disassembly of 9" Down Jar

NOTE: Before disassembly of Down Jar, fully open tool and then close tool approximately 1/8".

For proper location and direction of seals, packing, wipers etc. during disassembly and assembly procedures refer to Figure 14, page 34. Mandrel Packing Retainer and Mandrel Body threads are left-handed.

1. Break all body joints using a vise and tong. (There will be 5 connections.) Be sure to support the tool with a jack stand at appropriate locations when breaking joints and when the jar is being disassembled.
2. With the Down Jar in a vise, clamp onto the bowl being careful not to injure the control ring plug. Completely unscrew the bottom Sub and set it on the floor.
3. Using a pair of Retainer Ring Pliers (see Service Kit, page 24), remove the Friction Mandrel Packing Adapter Packing Retainer Ring (Snap Ring) from the Friction Mandrel Packing Adapter and let it hang on the Friction Mandrel.
4. Loosen the Friction Mandrel Packing Adapter Packing Retainer with the Spanner Wrench (Part No.13490) provided in the Jar Service Kit, page 24, but do not remove the Retainer.

5. Put a pipe wrench on the exposed area of the Friction Mandrel being careful not to injure the snap ring. This wrench will act as a back-up. Place another wrench on the wrench area of the Friction Mandrel Packing Adapter and break the adapter free using an overhead crane if necessary. Remove the Friction Mandrel Packing Adapter assembly and the loose snap ring.
6. Completely disassemble the Friction Mandrel Packing Adapter assembly by completely unscrewing the packing retainer and removing the packing set and the wiper seal.
7. Clamp the jar in a vise on the Connector Body. Unscrew and remove the Bowl. If the Bowl Liner stays in the Bowl, remove the liner by engaging the 1" diameter holes in the center of the liner and slide the liner out of the Bowl. Remove two O-Rings on the Bowl.
8. Remove the Control Ring Plug using the Control Ring Plug Wrench (Part No. 80733 — see Service Kit on page 24). Remove the Control Ring Plug Seal.
9. Reach into the Bowl and remove the Control Ring. The Control Ring Wrench (Part No. 92195 — see Service Kit, page 24) may be used to remove the Control Ring if desired.

NOTE: The Control Ring has right-hand threads.

10. If the Bowl Liner stayed on the Friction Mandrel, remove it by sliding the liner off the end of the Friction Mandrel.

11. Clamp the jar in a vise on the Spline Body.
12. Using a pipe wrench and overhead crane, break out and remove the Friction Mandrel. Be sure to place the pipe wrench in the wrench area of the Friction Mandrel next to the Friction Slip. Remove the Spacer Sleeve Ring, the Spacer Sleeve, and the Friction Slip. The Friction Slip can be removed by sliding it toward the end of the Friction Mandrel away from the wrench area. Remove O-Rings on the Friction Mandrel (see next step).
13. If the connection between the Mandrel Connector and Mandrel breaks loose instead of the connection between Mandrel Connector and Friction Mandrel (as in the previous step), a different procedure should be used. Fully unscrew the Mandrel Connector and remove the Spacer Sleeve and Mandrel O-Ring. Screw the Mandrel Connector fully on the Mandrel. Place a back-up wrench on the wrench area of the Mandrel Connector and break out the Friction Mandrel. Be sure to place the wrench near the Mandrel Connector on the wrench area of the Friction Mandrel. Then remove the Spacer Sleeve Ring and Friction Slip (as in previous step).
14. Using a straight edge, scribe a line along the length of the tool from the Mandrel to the Spline Body (this line will be used in reassembly).
15. Break loose and remove the Mandrel Connector using a pipe wrench and overhead crane. Apply the wrench on the wrench area only. Remove the Mandrel by sliding it out of the Mandrel Packing Retainer. Support the weight of the Mandrel as it is being removed.

NOTE: The Mandrel may be removed by screwing the previously removed Bowl onto the Connector Body about 6 turns. Then screw the Bottom Sub onto the Bowl about 6 turns. Attach jar tester ends to the Mandrel and Bottom Sub. Place the assembly in the jar tester and pull the Mandrel out of the jar. Remove the O-Ring.

16. Unscrew and remove the Bottom Sub, Bowl, and Connector Body. Remove the O-Rings.
17. Reposition the jar and clamp the vise on the Mandrel Body. Fully unscrew and remove the Spline Body (left-hand threads). Remove the O-Rings.
18. Fully unscrew and remove the Mandrel Packing Retainer (left-hand threads). Remove the Mandrel Packing Retainer Wiper and the eleven wear rings using Part No. 71818 or equivalent. Remove the O-Ring.
19. Remove the Mandrel Body Packing Set and the Mandrel Body Seal. Remove the Mandrel Body from the vise. Disassembly is complete.

The jar parts should be thoroughly cleaned and all parts checked for defects or excessive wear. Make sure that the vent hole behind the wiper in the Mandrel Packing Retainer and the Friction Mandrel Packing Adapter is clean. Any small scratches or rough areas can be smoothed using fine emery cloth or equivalent. Examine the Friction Slip, Friction Mandrel and the Bowl Liner for damage or excessive wear. Check the tool joints for damage. Magnetic particle inspect all body parts for fatigue cracks. Rustproof all parts with a light coat of oil and protect the parts from the weather.

Reassembly of the 9" Down Jar

Prior to reassembly, the parts should all be thoroughly cleaned and dried. Make sure all parts are in good condition. Coat them with a thin oil, if not already done, and lay them out on clean cloths or kraft paper. Be sure three (3) or four (4) lbs. of Bowen Itcolube is on hand. (It should be noted that no other lube is satisfactory for this tool in areas of severe friction and bearing loads, such as the splines.) All threaded connections except the Control Ring Plug should be coated with Itcolube prior to make-up. Be sure the diameters on either side of the threads and the shoulders are thoroughly greased with Itcolube. Failure to grease properly can lead to galling and excessive wear of parts!

The jar will normally require a complete packing set (Part No. 102125) each time it is redressed. The packing should be installed into or onto the jar parts prior to assembly. Be sure to grease the packing with cup grease before assembly. See Figure 14 on page 34 as a guide to proper installation.

NOTE: Support the tool with a jack stand at appropriate locations on reassembly.

1. Clamp the Mandrel Body on a vise. Make sure the Mandrel Body Packing Set and the Mandrel Body Seal have been properly installed. Pick up the Mandrel Packing Retainer and after checking that the O-Ring, the wear rings, and the wiper have been correctly installed, make it up to the Mandrel Body (left-hand threads). However, do not make it up fully, but leave the threaded joint approximately 1/8" open. This will make it easier to assemble the Mandrel.
2. Pick up the Spline Body. Generously grease the internal spline with Itcolube. Then fully make up the Spline Body into the Mandrel Body (left-hand threads).

3. Pick up the Connector Body and fully make it up into the Spline Body. Both ends are the same on the Connector Body to prevent assembly error. Make sure all O-Rings have been installed.

4. Generously grease the entire I.D. of the Mandrel Packing Retainer using cup grease. Take a straight edge and extend the line from the Spline Body across the Mandrel Body and the Mandrel Packing Retainer. This line will be used to align the splines for installation of the Mandrel.

5. Pick up the Bottom sub and screw it on the Connector Body about 6 turns. Pick up and screw the Bottom Sub onto the Bowl about 6 turns. Install a jar tester sub on the end of the Bottom Sub. Pick up the Mandrel and thoroughly grease the Spliner. Slide the Mandrel into the Mandrel Packing Retainer being careful not to damage the seals or wear rings. Slide the Mandrel into the Mandrel Packing Retainer as far as it will go by hand. Install a jar tester sub on the end of the Mandrel. Rotate the Mandrel as needed to align the scribed line on the Mandrel with the scribed line on the Spline Body.

6. Pick up the jar assembly with a crane and place it in the Jar Tester (see Figure 9 on page 18). After checking alignment of the scribed liner, push the Mandrel into the assembly using no more than 4,000 to 8,000 pounds. Do not fully insert the Mandrel, but stop when the distance between the Mandrel shoulder and the Mandrel Packing Retainer is about 11-3/4 inches. Remove the jar assembly from the tester and place it in a vise. Clamp on the Spline Body.

7. Remove the Bowl and Bottom Sub (which were used for Mandrel installation). Pick up the Mandrel Connector and fully tighten it onto the Mandrel. Fully tighten the Mandrel Connector by placing a pipe wrench on the wrench area.

NOTE: A 60-inch pipe wrench with a three-foot extension pipe (cheater) will provide sufficient torque when manually tightened. File-off and clean any large burrs made by the pipe wrench.

8. Coat the Friction Slip and the Friction Slip area of the Friction Mandrel with Friction Slip Lube, Part No. 74285 or 102069. Pick up the Friction Mandrel and slide the Friction Slip on the Friction Mandrel until it stops. (The smaller end of the Friction Slip goes on first.) Slide the Friction Slip past the first 'bump' on the Friction Mandrel by using a suitable wooden block to knock it past the 'bump'. Make sure the O-Rings are installed on the Friction Mandrel.

9. Thoroughly grease the O.D. and I.D. of the Spacer Sleeve with Friction Slip Lube and slide the sleeve over the Mandrel Connector. Pick up the Spacer Sleeve Ring and slide it over the Friction Mandrel until it shoulders against the Friction Slip.

NOTE: The Spacer Sleeve Rings must be installed with the washer spring toward the Friction Slip. Pick up the Friction Mandrel assembly and fully screw it into the Mandrel Connector. Fully tighten the Friction Mandrel by placing a pipe wrench on the wrench area of the Friction Mandrel next to the Friction Slip.

NOTE: A 60-inch pipe wrench will provide sufficient torque when manually tightened. File off any burrs and clean the wrench area.

10. Pick up the Control Ring and lightly grease the threads with Friction Slip Lube. Screw the Control Ring into the Bowl until the milled slots in the Control Ring are almost across the Control Ring Plug hole in the Bowl.

NOTE: Threads are right-handed. Control Ring Plug Wrench (Part No. 392195 – see Service Kit, page 24) may be used if installation is difficult by hand. Pick up the Bowl Liner and grease it completely with Friction Slip Lube. Slide the Bowl Liner into the Bowl until it shoulders. (The thick end of the Bowl Liner shoulders in the Bowl.) Pick up the Bowl and carefully slide it over the Friction Mandrel. Fully screw it onto the Connector Body.

11. Pick up the Friction Mandrel Packing Adapter. Install the Friction Mandrel Packing Adapter Wiper Seal. Grease the Friction Mandrel Packing Adapter Packing Set and install it fully on the Friction Mandrel Packing Adapter noting correct direction. Fully install the Friction Mandrel Packing Adapter Packing Retainer using a Spanner Wrench (Part No. 13490 — see Service Kit on page 24). Install the Friction Mandrel Packing Adapter Packing Retainer Ring using a pair of Retainer Ring Pliers (see Service Kit on page 24).
12. Pick up the Friction Mandrel Packing Adapter and screw it onto the Friction Mandrel. Fully tighten the Friction Mandrel Packing Adapter by using a pipe wrench in the wrench area of the Adapter. Be careful to stay fully in the wrench area when tightening. Manually tighten the adapter. File off and clean any burrs.

13. Thoroughly grease the entire seal bore of the Bottom Sub with cup grease or Itcolube. Pick up the Bottom Sub and carefully push it over the packing on the Friction Mandrel Packing Adapter. Fully screw the Bottom Sub on the Bowl. The jar is ready for testing.

Testing the Down Jar

1. Make sure the Jar Tester subs are installed. Using crane, place Down Jar in Tester and pull it open to full stroke length. Set Jar Tester at standard test load.
2. Using the handle of Control Ring Plug Wrench, No. 80733, or a large screwdriver as a lever, reach inside Control Ring Plug hole and turn Control Ring until Rig slots are in the center of the Plug hole in the up-and-down direction. The Control Ring has right-hand threads. Actuate the Jar Tester and record the trip load. If the tool does not trip through at standard test load, rotate the Control Ring in the down-load (downhole) direction four (4) slots each time until it does trip.

If tool shows no-load, rotate the Control Ring in the up-load (up hole) direction six (6) slots on each test until a load build-up occurs. Adjust Control Ring and continue tests until standard test load is reached. Do not try to reach exact load; plus or minus two (2) tons is satisfactory.
3. Determine the load adjustment rate of increase by adjusting the Control Ring in the up direction 5 slots, test and record this load. Then adjust the Control Ring down 10 slots, test and record this load.
4. Reset to field use load setting.

5. Using handle of the Control Ring Plug Wrench or a large screwdriver, move the Control Ring until the nearest slot is centered through the plug hole in the side-to-side direction. Move it only enough so that the dog point on the Plug will enter the slot, which locks the Ring in place. Spread a good quality thread locking compound on threads of the Control Ring Plug, and, using the Control Ring Wrench, install it tightly into the hole.
6. Pull Down Jar open and remove it from the Tester. Remove Jar Tester subs and return them to storage. Install Dog Collars on the Mandrel making sure to insert the pin from the upward end so that it does not fall out when the tool is moved to a vertical position.

Bowen Hydromechanical 9" Drilling Jar

Size Connection		7 ⁵ / ₈ API Reg.	Connector Body Seal	Part No.	102089
Minimum O.D. (Inches)		9	Connector Body Packing Set (Upper)	Part No.	102091
I.D. (Inches)		3 ¹ / ₁₆	Fill Plug	Part No.	102025
Length (Up Jar & Down Jar Assemblies - Open Connected)		41' - 6 ¹ / ₂ "	Fill Plug Seal	Part No.	568-010
Torsional Yield In LB./FT.		271,266	Fill Plug Back-up Ring	Part No.	8-010
Tensile Load Yiled Capacity In LBS.		1,936,000	Piston Assembly (Cone Type)	Part No.	102138
Complete Assembly Consisting Of:	Part No.	102074	Cone	Part No.	102092
Up Jar Assembly	Part No.	102072	By Pass Body	Part No.	102093
Length (Open)		19' - 11 ¹ / ₂ "	Seal Body	Part No.	102094
Length Stroke (Inches)		14"	Seal Body Seal	Part No.	102095
Down Jar Assembly	Part No.	102073	Washpipe	Part No.	102096
Length (Open)		21'-7"	Washpipe Seal	Part No.	30-26
Total Stroke (Inches)		12'	Floater	Part No.	102097
Replacement Parts For Up Jar Assembly			Floater Seal (O.D.)	Part No.	568-363
Up Jar Assembly	Part No.	102072	Floater Seal (I.D.)	Part No.	102098
Spline Body	Part No.	102075	Pressure Body	Part No.	102099
Spline Body Seal (Large)	Part No.	30-43	Fill Plug	Part No.	102025
Spline Body Seal (Small)	Part No.	30-41	Fill Plug Seal	Part No.	568-010
Mandrel Body	Part No.	102076	Fill Plug Back-up Ring	Part No.	8-010
Mandrel Body Packing Set	Part No.	102077	Washpipe Body	Part No.	102100
Mandrel Packing Retainer	Part No.	102078	Washpipe Body Seal (Small)	Part No.	30-39
Mandrel Packing Retainer Wear Ring	Part No.	102079	Washpipe Body Seal (Large)	Part No.	30-41
Mandrel Packing Retainer Wiper	Part No.	102080	Required Accessories		
Mandrel Packing Retainer Seal	Part No.	30-43	Thread Protector (Pin)	Part No.	65702
Mandrel	Part No.	102081	Thread Protector (Box)	Part No.	81433
Mandrel Seal	Part No.	30-27	Packing Assembly Sleeve (Mand. Ext.)	Part No.	102127
Mandrel Extension	Part No.	102082	Dog Collar	Part No.	102126
Mandrel Extension Packing Set	Part No.	102083	Service Kit	Part No.	77215
Mandrel Extension Wiper Seal	Part No.	102084	Extra		
Mandrel Extension Packing Retainer	Part No.	102085	Complete "O"-ring Packing Set	Part No.	102128
Mandrel Extension Packing Retainer Ring	Part No.	102086	Complete Packing Set	Part No.	102129
Mandrel Extension Seal	Part No.	30-21	Bottleneck Elevator Lift Sub Pin	Part No.	146403
Connector Body	Part No.	102087	Bottleneck Elevator Lift Sub Box	Part No.	81432
Connector Body Wiper	Part No.	102088	Wear Ring & Wiper Installation Tool	Part No.	71817
Connector Body Seal (Large)	Part No.	30-41	Wear Ring & Wiper Removal Tool	Part No.	71818
Connector Body Seal (Small)	Part No.	30 - 39			

Bowen Hydromechanical 9" Drilling Jar

Replacement Parts For Down Jar			Friction Mandrel Packing Adapter Packing Set	Part No.	102113
Down Jar Assembly	Part No.	102073	Friction Mandrel Packing Adapter Packing Retainer Ring	Part No.	69264
Spline Body	Part No.	102101	Friction Mandrel Packing Adapter Packing Retainer	Part No.	102114
Spline Body (Large)	Part No.	30-43	Bowl	Part No.	102115
Spline Body Seal (Small)	Part No.	30-41	Bowl Seal (Large)	Part No.	30-41
Mandrel Body	Part No.	102102	Bowl Seal (Small)	Part No.	30-39
Mandrel Body Packing Set	Part No.	102077	Bowl Liner	Part No.	102116
Mandrel Body Seal	Part No.	102103	Control Ring	Part No.	102117
Mandrel Packing Retainer	Part No.	102078	Control Ring Plug	Part No.	102118
Mandrel Packing Retainer Wear Ring	Part No.	102079	Control Ring Plug Seal	Part No.	80998
Mandrel Packing Retainer Wiper	Part No.	102080	Bottom Sub	Part No.	102119
Mandrel Packing Retainer Seal	Part No.	30-43	Required Accessories		
Mandrel	Part No.	102104	Thread Protector For Pin Connector	Part No.	65702
Mandrel Seal	Part No.	30-25	Thread Protector For Box Conn.	Part No.	81433
Mandrel Connector	Part No.	102105	Dog Collar Assembly	Part No.	102137
Connector Body	Part No.	102106	Service Kit (1 Req'd For Up And Down Jar)	Part No.	77215
Connector Body Seal (Large)	Part No.	30 -41	Control Ring Plug Adhesive	Part No.	77628
Connector Body Seal (Small)	Part No.	30-40	Extra		
Spacer Sleeve	Part No.	102107	Complete "O"-ring Set	Part No.	102124
Spacer Sleeve Ring	Part No.	102108	Complete Packing Set	Part No.	102125
Spacer Sleeve Ring Spring	Part No.	102158	Friction Slip Lube (1 Tube)	Part No.	74285
Friction Mandrel	Part No.	102109	Friction Slip Lube (1 Gallon)	Part No.	79684
Friction Mandrel Upper Seal (Large)	Part No.	30-21	Bottleneck Elevator Lift Sub (Pin)	Part No.	146403
Friction Mandrel Upper Seal (Small)	Part No.	30-19	Bottleneck Elevator Lift Sub (Box)	Part No.	81432
Friction Slip	Part No.	102110	Wear Ring & Wiper Installation Tool	Part No.	71817
Friction Mandrel Packing Adapter	Part No.	102111	Wear Ring & Wiper Removal Tool	Part No.	71818
Friction Mandrel Packing Adapter Wiper Seal	Part No.	102112			

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* Denotes Manufacturing and Engineering facilities

Downhole Solutions

Drilling Solutions

Engineering and Project Management Solutions

Lifting and Handling Solutions

Production Solutions

Supply Chain Solutions

Tubular and Corrosion Control Solutions

Well Service and Completion Solutions